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ABSTRACT

With this Career and Technologies Studies (CTS) curriculum guide, secondary students in Alberta can do the following: develop skills that can be applied in their daily lives; refine career-planning skills; develop technology-related skills in electro-technologies; enhance employability skills, especially in electro-technologies industries; and apply and reinforce learning developed in other subject areas. The curriculum is organized in strands and modules. This guide encompassing the electro-technologies strand contains 37 modules that define what a student is expected to know and be able to do (competencies). The guide is organized in the following parts: (1) program rationale and philosophy, learner expectations, program organization, curriculum and assessment standards, and types of competencies in career and technology studies; (2) strand rationale and philosophy and strand organization for electro-technologies studies; (3) planning for instruction for career and technology studies and for electro-technologies courses; (4) module curriculum and assessment standards for introductory level electro-technologies competencies; (5) module curriculum and assessment standards for intermediate level electro-technologies competencies; (6) module curriculum and assessment standards for advanced level electro-technologies competencies; (7) assessment tools; (8) linkages and transitions; (9) learning resource guide; and (10) sample student learning guides. Modules cover the following broad topics: electro-assembly; conversion and distribution; power supply; digital technology; control systems; analog, electronic, and radio communication; security systems; robotics; circuit wiring; electro-optics; magnetic control; electronic servicing; generation/transformation; microprocessors; amplifiers; motors; and control applications. (KC)

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CAREER & TECHNOLOGY STUDIES

ELECTRO–TECHNOLOGIES

GUIDE TO STANDARDS AND IMPLEMENTATION

1997

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This document was prepared for:

Administrators	✓
Counsellors	✓
General Audience	
Parents	
Students	
Teachers	✓

Program/Level: Career and Technology Studies/Secondary

This document supersedes all previous versions of the *Career & Technology Studies Guide to Standards and Implementation*.

This publication is a support document. The advice and direction offered is suggestive except where it duplicates the Program of Studies. The Program of Studies—a prescriptive description of the expectations of student learning, focusing on what students are expected to know and be able to do—is issued under the authority of the Minister of Education pursuant to section 25(1) of the *School Act*, Statutes of Alberta, 1988, Chapter S–3.1 as amended, and is required for implementation. **Within this document, the Program of Studies is shaded so that the reader may readily identify all prescriptive statements or segments.**

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CAREER AND TECHNOLOGY STUDIES

A. PROGRAM RATIONALE AND PHILOSOPHY

Through Career and Technology Studies (CTS), secondary education in Alberta is responding to the many challenges of modern society, helping young people develop daily living skills and nurturing a flexible, well-qualified work force.

In Canada's information society, characterized by rapid change in the social and economic environment, students must be confident in their ability to respond to change and successfully meet the challenges they face in their own personal and work lives. In particular, they make decisions about what they will do when they finish high school. Many students will enter the work force, others will continue their education. All students face the challenges of growing independence and responsibility, and of entering post-secondary programs and/or the highly competitive workplace.

Secondary schools also face challenges. They must deliver, on a consistent basis, high quality, cost-effective programs that students, parents and the community find credible and relevant.

CTS helps schools and students meet these challenges. Schools can respond more efficiently and effectively to student and community needs and expectations by taking advantage of the opportunities in the CTS curriculum to design courses and access school, community and distance learning resources. Students can develop the confidence they need as they move into adult roles by assuming increased responsibility for their learning; cultivating their individual talents, interests and abilities; and by defining and acting on their goals.

As an important component of education in Alberta secondary schools, CTS promotes student achievement by setting clear expectations and recognizing student success. Students in CTS develop competencies—the knowledge, skills and attitudes they are expected to demonstrate, that is, what they know and what they are able to do.

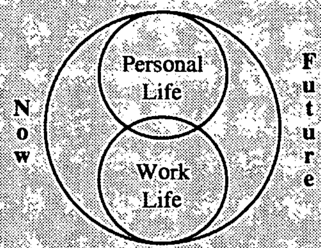
Acquired competencies can be applied now and in the future as students make a smooth transition into adult roles in the family, community, workplace and/or further education. To facilitate this transition, clearly stated expectations and standards have been defined in cooperation with teachers, business and industry representatives and post-secondary educators.

CTS offers all students important learning opportunities. Regardless of the particular area of study chosen, *students* in CTS *will*:

- develop skills that can be applied in their daily lives, now and in the future
- refine career-planning skills
- develop technology-related skills
- enhance employability skills
- apply and reinforce learnings developed in other subject areas.

In CTS, students build skills they can apply in their everyday lives. For example, in the CTS program, particularly at the introductory levels, students have the opportunity to improve their ability to make sound consumer decisions and to appreciate environmental and safety precautions.

CAREERS



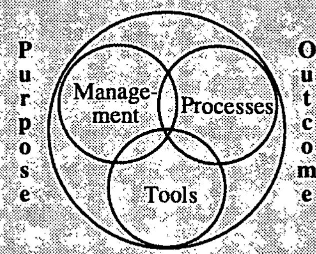
A career encompasses more than activities just related to a person's job or occupation; it involves one's personal life in both local and global contexts; e.g., as a family member, a friend, a community volunteer, a citizen of the world.

The integration of careers throughout the CTS program helps students to make effective career decisions and to target their efforts. CTS students will have the opportunity to expand their knowledge about careers, occupations and job opportunities, as well as the education and/or training requirements involved. Also, students come to recognize the need for lifelong learning.

Students in CTS have the opportunity to use and apply technology and systems effectively and efficiently. This involves:

- a decision regarding which processes and procedures best suit the task at hand
- the appropriate selection and skilled use of the tools and/or resources available
- an assessment of and management of the impact the use of the technology may have on themselves, on others and on the environment.

TECHNOLOGY



Integrated throughout CTS are employability skills, those basic competencies that help students develop their personal management and social skills. Personal management skills are improved as students take increased responsibility for their learning, design innovative solutions to problems and challenges, and manage resources effectively and efficiently. Social skills improve through learning experiences that require students to work effectively with others, demonstrate teamwork and leadership, and maintain high standards in safety and accountability.

As well as honing employability skills, CTS reinforces and enhances learnings developed in core and other complementary courses. The curriculum emphasizes, as appropriate, the effective application of communication and numeracy skills.

In addition to the common outcomes described above, students focusing on a particular area of study will develop career-specific competencies that support entry into the workplace and/or related post-secondary programs. Career-specific competencies can involve understanding and applying appropriate terminology, processes and technologies related to a specific career, occupation or job.

GENERAL LEARNER EXPECTATIONS

General learner expectations describe the basic competencies integrated throughout the CTS program.

Within an applied context relevant to personal goals, aptitudes and abilities; *the student* in CTS *will*:

- demonstrate the basic knowledge, skills and attitudes necessary for achievement and fulfillment in personal life
- develop an action plan that relates personal interests, abilities and aptitudes to career opportunities and requirements
- use technology effectively to link and apply appropriate tools, management and processes to produce a desired outcome
- develop basic competencies (employability skills), by:
  - selecting relevant, goal-related activities, ranking them in order of importance, allocating necessary time, and preparing and following schedules (managing learning)
  - linking theory and practice, using resources, tools, technology and processes responsibly and efficiently (managing resources)
  - applying effective and innovative decision-making and problem-solving strategies in the design, production, marketing and consumption of goods and services (problem solving and innovation)
  - demonstrating appropriate written and verbal skills, such as composition, summarization and presentation (communicating effectively)
  - participating as a team member by working cooperatively with others and contributing to the group with ideas, suggestions and effort (working with others)
  - maintaining high standards of ethics, diligence, attendance and punctuality, following safe procedures consistently, and recognizing and eliminating potential hazards (demonstrating responsibility).

PROGRAM ORGANIZATION

CURRICULUM STRUCTURE

Career and Technology Studies is organized into **strands** and **modules**.

Strands in CTS define competencies that help students:

- build daily living skills
- investigate career options
- use technology (managing, processes, tools) effectively and efficiently
- prepare for entry into the workplace and/or related post-secondary programs.

In general, strands relate to selected industry sectors offering positive occupational opportunities for students. Some occupational opportunities require further education after high school, and some allow direct entry into the workplace. Industry sectors encompass goods-producing industries, such as agriculture, manufacturing and construction; and service-producing industries, such as business, health, finance and insurance.

Modules are the building blocks for each strand. They define what a student is expected to know and be able to do (exit-level *competencies*). Modules also specify prerequisites. Recommendations for module parameters, such as instructional qualifications, facilities and equipment can be found in the guides to implementation.

The competencies a student must demonstrate to achieve success in a module are defined through the *module learner expectations*. Senior high school students who can demonstrate the module learner expectations; i.e., who have the designated competencies, will qualify for one credit toward their high school diploma.

Specific learner expectations provide a more detailed framework for instruction. Within the context of module learner expectations, the specific learner expectations further define the knowledge, skills and attitudes the student should acquire.

The following chart shows the 22 strands that comprise the CTS program and the number of modules available in each strand.

Strand	No. of Modules
1. Agriculture	33
2. Career Transitions	28
3. Communication Technology	33
4. Community Health	31
5. Construction Technologies	46
6. Cosmetology	58
7. Design Studies	31
8. Electro-Technologies	37
9. Energy and Mines	26
10. Enterprise and Innovation	8
11. Fabrication Studies	41
12. Fashion Studies	29
13. Financial Management	14
14. Foods	37
15. Forestry	21
16. Information Processing	48
17. Legal Studies	13
18. Logistics	12
19. Management and Marketing	19
20. Mechanics	54
21. Tourism Studies	24
22. Wildlife	17

LEVELS OF ACHIEVEMENT

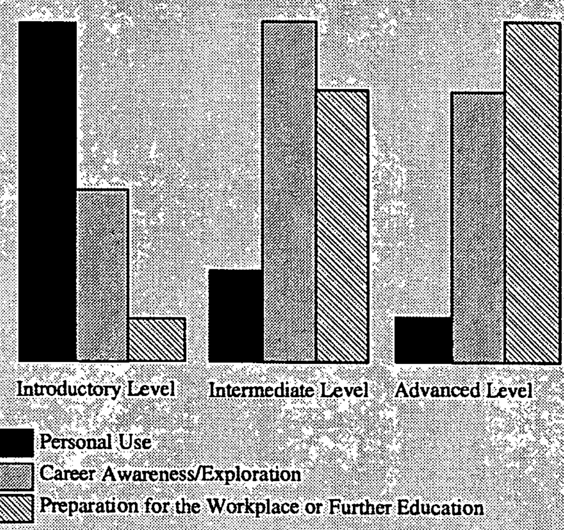
Modules are organized into three levels of achievement: **introductory**, **intermediate** and **advanced**. As students progress through the levels, they will be expected to meet higher standards and demonstrate an increased degree of competence, in both the general learner expectations and the module learner expectations.

Introductory level modules help students build daily living skills and form the basis for further learning. Introductory modules are for students who have no previous experience in the strand.

Intermediate level modules build on the competencies developed at the introductory level. They provide a broader perspective, helping students recognize the wide range of related career opportunities available within the strand.

Advanced level modules refine expertise and help prepare students for entry into the workplace or a related post-secondary program.

The graph below illustrates the relative emphasis on the aspects of career planning at each of the levels.



CURRICULUM AND ASSESSMENT STANDARDS

Curriculum standards in CTS define what students must know and be able to do. Curriculum standards are expressed through general learner expectations for CTS, and through module and specific learner expectations for each strand.

Assessment standards define how student performance is to be judged. In CTS, each assessment standard defines the conditions and criteria to be used for assessing the competencies of each module learner expectation. To receive credit for a module, students must demonstrate competency at the level specified by the conditions and criteria defined for each module learner expectation.

Students throughout the province receive a fair and reliable assessment as they use the standards to guide their efforts, thus ensuring they participate more effectively and successfully in the learning and assessment process. Standards at advanced levels are, as much as possible, linked to workplace and post-secondary entry-level requirements.

TYPES OF COMPETENCIES

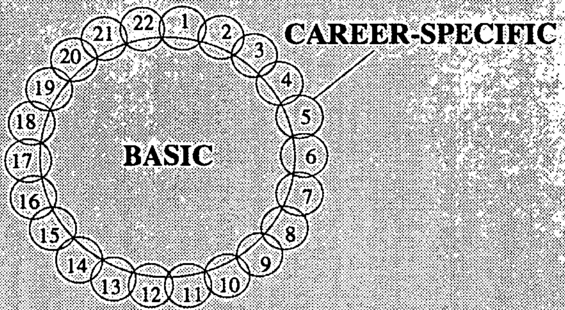
Two types of competencies are defined within the CTS program: basic and career-specific.

Basic competencies are generic to any career area and are developed within each module. Basic competencies include:

- personal management; e.g., managing learning, being innovative, ethics, managing resources
- social; e.g., communication, teamwork, leadership and service, demonstrating responsibility (safety and accountability).

Career-specific competencies relate to a particular strand. These competencies build daily living skills at the introductory levels and support the smooth transition to the workplace and/or post-secondary programs at the intermediate and advanced levels.

The model below shows the relationship of the two types of competencies within the 22 strands of the CTS program.



BASIC COMPETENCIES REFERENCE GUIDE

The chart below outlines basic competencies that students endeavour to develop and enhance in each of the CTS strands and modules. Students' basic competencies should be assessed through observations involving the student, teacher(s), peers and others as they complete the requirements for each module. In general, there is a progression of task complexity and student initiative as outlined in the Developmental Framework★. **As students progress through Stages 1, 2, 3 and 4 of this reference guide, they build on the competencies gained in earlier stages.** Students leaving high school should set themselves a goal of being able to demonstrate Stage 3 performance.

Suggested strategies for classroom use include:

- having students rate themselves and each other
- using in reflective conversation between teacher and student
- highlighting areas of strength
- tracking growth in various CTS strands
- highlighting areas upon which to focus
- maintaining a student portfolio.

Stage 1— *The student:*	**Stage 2**— *The student:*	**Stage 3**— *The student:*	**Stage 4**— *The student:*
Managing Learning			
☐ comes to class prepared for learning	☐ ⟶	☐ ⟶	☐ ⟶
☐ follows basic instructions, as directed	☐ follows instructions, with limited direction	☐ follows detailed instructions on an independent basis	☐ ⟶
	☐ sets goals and establishes steps to achieve them, with direction	☐ sets clear goals and establishes steps to achieve them	☐ demonstrates self-direction in learning, goal setting and goal achievement
☐ acquires specialized knowledge, skills and attitudes	☐ applies specialized knowledge, skills and attitudes in practical situations	☐ transfers and applies specialized knowledge, skills and attitudes in a variety of situations	☐ transfers and applies learning in new situations; demonstrates commitment to lifelong learning
☐ identifies criteria for evaluating choices and making decisions	☐ identifies and applies a range of effective strategies for solving problems and making decisions	☐ uses a range of critical thinking skills to evaluate situations, solve problems and make decisions	☐ thinks critically and acts logically to evaluate situations, solve problems and make decisions
☐ uses a variety of learning strategies	☐ explores and uses a variety of learning strategies, with limited direction	☐ selects and uses effective learning strategies	☐ ⟶
		☐ cooperates with others in the effective use of learning strategies	☐ provides leadership in the effective use of learning strategies
Managing Resources			
☐ adheres to established timelines; uses time/schedules/planners effectively	☐ creates and adheres to timelines, with limited direction; uses time/ schedules/planners effectively	☐ creates and adheres to detailed timelines on an independent basis; prioritizes task; uses time/ schedules/planners effectively	☐ creates and adheres to detailed timelines; uses time/schedules/ planners effectively; prioritizes tasks on a consistent basis
☐ uses information (material and human resources), as directed	☐ accesses and uses a range of relevant information (material and human resources), with limited direction	☐ accesses a range of information (material and human resources), and recognizes when additional resources are required	☐ uses a wide range of information (material and human resources) in order to support and enhance the basic requirement
☐ uses technology (facilities, equipment, supplies), as directed, to perform a task or provide a service	☐ uses technology (facilities, equipment, supplies), as appropriate, to perform a task or provide a service, with minimal assistance and supervision	☐ selects and uses appropriate technology (facilities, equipment, supplies) to perform a task or provide a service on an independent basis	☐ recognizes the monetary and intrinsic value of managing technology (facilities, equipment, supplies)
☐ maintains, stores and/or disposes of equipment and materials, as directed	☐ maintains, stores and/or disposes of equipment and materials, with limited assistance	☐ maintains, stores and/or disposes of equipment and materials on an independent basis	☐ demonstrates effective techniques for managing facilities, equipment and supplies
Problem Solving and Innovation			
☐ participates in problem solving as a process ☐ learns a range of problem-solving skills and approaches	☐ identifies the problem and selects an appropriate problem-solving approach, responding appropriately to specified goals and constraints	☐ thinks critically and acts logically in the context of problem solving	☐ identifies and resolves problems efficiently and effectively
☐ practices problem-solving skills by responding appropriately to a clearly defined problem, specified goals and constraints, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ applies problem-solving skills to a directed or a self-directed activity, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ transfers problem-solving skills to real-life situations, by generating new possibilities ☐ prepares implementation plans ☐ recognizes risks	☐ identifies and suggests new ideas to get the job done creatively, by: – combining ideas or information in new ways – making connections among seemingly unrelated ideas – seeking out opportunities in an active manner

Stage 1— *The student:*	**Stage 2**— *The student:*	**Stage 3**— *The student:*	**Stage 4**— *The student:*
Communicating Effectively			
☐ uses communication skills; e.g., reading, writing, illustrating, speaking	☐ communicates thoughts, feelings and ideas to justify or challenge a position, using written, oral and/or visual means	☐ prepares and effectively presents accurate, concise, written, visual and/or oral reports providing reasoned arguments	☐ negotiates effectively, by working toward an agreement that may involve exchanging specific resources or resolving divergent interests
☐ uses language in appropriate context	☐ uses technical language appropriately	☐ encourages, persuades, convinces or otherwise motivates individuals	☐ negotiates and works toward a consensus
☐ listens to understand and learn	☐ listens and responds to understand and learn	☐ listens and responds to understand, learn and teach	☐ listens and responds to understand, learn, teach and evaluate
☐ demonstrates positive interpersonal skills in selected contexts	☐ demonstrates positive interpersonal skills in many contexts	☐ demonstrates positive interpersonal skills in most contexts	☐ promotes positive interpersonal skills among others
Working with Others			
☐ fulfills responsibility in a group project	☐ →	☐ seeks a team approach, as appropriate, based on group needs and benefits; e.g., idea potential, variety of strengths, sharing of workload	☐ leads, where appropriate, mobilizing the group for high performance
☐ works collaboratively in structured situations with peer members	☐ cooperates to achieve group results	☐ works in a team or group: – encourages and supports team members – helps others in a positive manner – provides leadership/ followership as required – negotiates and works toward consensus as required	☐ understands and works within the context of the group
☐ acknowledges the opinions and contributions of others in the group	☐ maintains a balance between speaking, listening and responding in group discussions		☐ prepares, validates and implements plans that reveal new possibilities
	☐ respects the feelings and views of others		
Demonstrating Responsibility			
Attendance			
☐ demonstrates responsibility in attendance, punctuality and task completion	☐ →	☐ →	☐ →
Safety			
☐ follows personal and environmental health and safety procedures	☐ recognizes and follows personal and environmental health and safety procedures	☐ establishes and follows personal and environmental health and safety procedures	☐ transfers and applies personal and environmental health and safety procedures to a variety of environments and situations
☐ identifies immediate hazards and their impact on self, others and the environment	☐ identifies immediate and potential hazards and their impact on self, others and the environment	☐ →	☐ →
☐ follows appropriate/emergency response procedures	☐ →	☐ →	☐ →
			☐ demonstrates accountability for actions taken to address immediate and potential hazards
Ethics			
☐ makes personal judgements about whether or not certain behaviours/actions are right or wrong	☐ assesses how personal judgements affect other peer members and/or family; e.g., home and school	☐ assesses the implications of personal/group actions within the broader community; e.g., workplace	☐ analyzes the implications of personal/group actions within the global context
			☐ states and defends a personal code of ethics as required

★**Developmental Framework**			
• *Simple task* • *Structured environment* • *Directed learning*	• *Task with limited variables* • *Less structured environment* • *Limited direction*	• *Task with multiple variables* • *Flexible environment* • *Self-directed learning, seeking assistance as required*	• *Complex task* • *Open environment* • *Self-directed/self-motivated*

ELECTRO-TECHNOLOGIES

B. STRAND RATIONALE AND PHILOSOPHY

Electro-Technologies, a strand in Career and Technology Studies, focuses on having students gain an understanding of electrical/electronic systems and subsystems. Students are motivated to learn by studying electrical/electronic systems in an activity-oriented environment. The strand is an excellent vehicle for students to acquire knowledge, skills and attitudes needed to adapt to a rapidly changing and expanding technological world.

Electro-Technologies enables students to problem solve system applications by working at a systems level before focusing on specific fundamentals. Once the concepts are established, the ideas are integrated and contextualized to create real applications.

The Electro-Technologies strand provides students with practical experiences related to the electrical/electronics industry. Within the philosophy of Career and Technology Studies, *students* in Electro-Technologies *will*:

- exercise safe work and environmental practices
- develop electro-technology literacy
- demonstrate the ability to interface various electrical/electronic components and systems
- develop problem-solving, design and decision-making skills
- develop relevant applied mathematics skills using algebra, trigonometry and geometry
- use scientific calculators and engineering notations
- demonstrate established procedures of operation as practised in the electrical/electronics industry
- demonstrate understanding of the use of software and hardware in the study of electrical/electronic systems
- develop the necessary skills and techniques to fabricate, modify and troubleshoot electrical/electronic systems and components
- demonstrate proficient use of test equipment
- demonstrate the differences between power, control, audio and digital systems
- develop basic competencies and skills that transfer to daily lives and career options
- develop leadership and teamwork skills

- develop knowledge, skills and attitudes required for the workplace and further education.

STRAND ORGANIZATION

DEVELOPMENTAL MODEL

The model depicts emphasis within the Electro-Technologies strand. The front face of the cube lists the themes and concepts that are integrated throughout the program. The right side indicates the learning contexts that will enable the student to meet the demands of daily living. The top of the cube depicts the anticipated outcomes which take the form of basic and career-specific knowledge, skills and attitudes that have been constructed by the learner.

THEMES

The modules in Electro-Technologies are grouped according to the following themes:

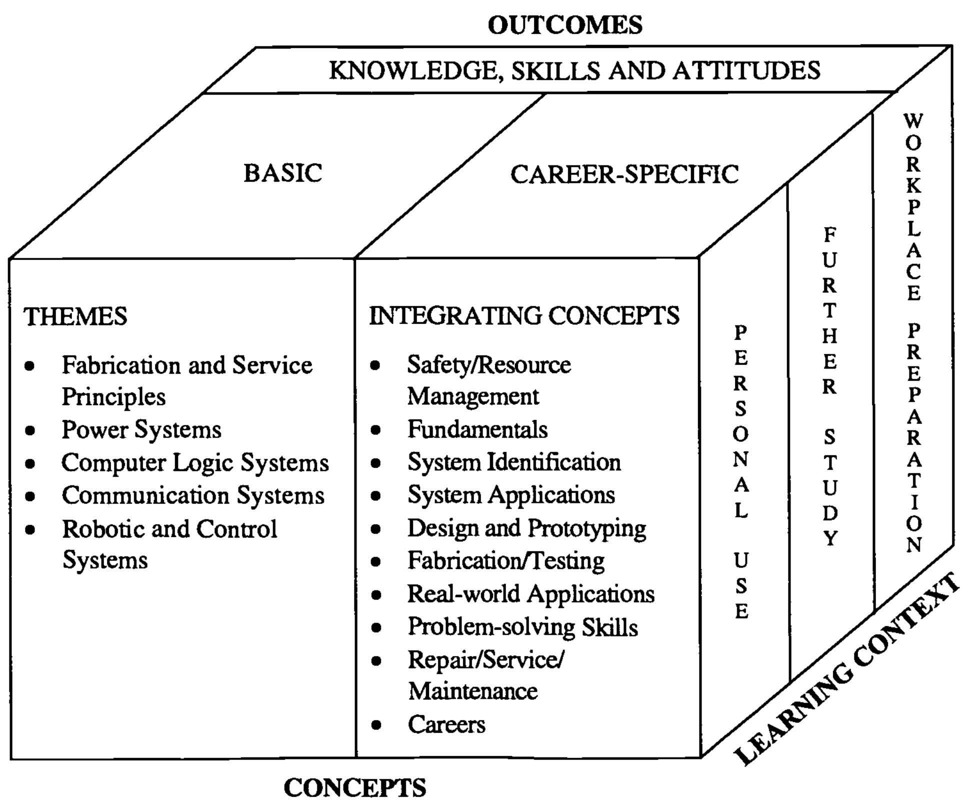
- Fabrication and Service Principles
- Power Systems
- Computer Logic Systems
- Communication Systems
- Robotic and Control Systems.

LEVELS

The Electro-Technologies modules are organized into three levels of learning: introductory, intermediate and advanced. The introductory level provides students with the basic knowledge, skills and attitudes necessary for personal use. The intermediate level focuses on the transferable knowledge, skills and attitudes that apply to many sectors of the industry. At the advanced level, students learn more career-specific knowledge, skills and attitudes that prepare them for a career in electrical/electronics industry or for further education or training.

CONCEPTS

Certain concepts are reinforced throughout the Electro-Technologies strand. These include safety and resource management, electrical/electronic fundamentals, real-world applications, fabrication and testing procedures, and problem solving. Emphasis will vary depending on module content, context and level.



SCOPE AND SEQUENCE — ELECTRO-TECHNOLOGIES

INTRODUCTORY	INTERMEDIATE	ADVANCED	THEME
Electro-assembly 1★ *ELT1010*	Electro-assembly 2 *ELT2010*	Electro-assembly 3 *ELT3010*	Fabrication and Service Principles
	Electrical Servicing *ELT2020*	Electronic Servicing *ELT3020*	
Conversion & Distribution *ELT1030*	Branch Circuit Wiring *ELT2030*	Power Systems & Services *ELT3030*	Power Systems
		Generation/Transformation *ELT3040*	
Electronic Power Supply 1◆ *ELT1050*	Electronic Power Supply 2 *ELT2050*		
Digital Technology 1◆ *ELT1060*	Digital Technology 2◆ *ELT2060*	Digital Technology 3 *ELT3060*	Computer Logic Systems
		Digital Applications *ELT3070*	
	Computer Technology *ELT2070*	Microprocessors *ELT3080*	
Control Systems 1◆ *ELT1080*	Control Systems 2 *ELT2080*	Microprocessor Interface *ELT3090*	
Analog Communication 1◆ *ELT1090*	Analog Communication 2 *ELT2090*	Analog Communication 3 *ELT3100*	Communication Systems
Electronic Communication◆ *ELT1100*	Radio Communication *ELT2100*	Amplifiers *ELT3110*	
Security Systems 1◆ *ELT1110*	Security Systems 2◆ *ELT2110*		
	Electro-optics◆ *ELT2120*	Data/Telemetry Systems *ELT3130*	
	Magnetic Control Devices◆ *ELT2130*	Motors◆ *ELT3140*	Robotic and Control Systems
Robotics 1◆ *ELT1130*	Robotics 2 *ELT2140*	Robotics 3 *ELT3150*	
	Electronic Controls◆ *ELT2150*	Control Applications *ELT3160*	

—— Prerequisite - - - - Recommended sequence

★Module provides a strong foundation for further learning in this strand.

◆Refer to specific modules for additional prerequisites.

MODULE DESCRIPTIONS

Module ELT1010: Electro-assembly 1
Students apply basic fabricating and servicing techniques to construct and test electronic and electromagnetic devices and cables.

Module ELT1030: Conversion & Distribution
Students experiment and work with principles of electrical energy conversion and distribution.

Module ELT1050: Electronic Power Supply 1
Students construct different types of alternating and direct current power supplies, and demonstrate their application in electrical/electronic systems.

Module ELT1060: Digital Technology 1
Students construct and demonstrate logic systems and their unique functions.

Module ELT1080: Control Systems 1
Students construct process control systems, demonstrate their basic operation, and demonstrate procedures for testing them.

Module ELT1090: Analog Communication 1
Students install and demonstrate the fundamentals of various consumer audio integrated systems.

Module ELT1100: Electronic Communication
Students demonstrate the fundamentals of video systems, and describe their uses.

Module ELT1110: Security Systems 1
Students install and demonstrate the fundamentals of sensors, control units and warning devices used in security systems.

Module ELT1130: Robotics 1
Students apply the fundamentals of robotic systems and basic robotic functions.

Module ELT2010: Electro-assembly 2
Students apply electro-assembly technology to manufacture circuit boards.

Module ELT2020: Electrical Servicing
Students demonstrate the fundamental concepts of repairing, servicing and maintaining electrical and electronic equipment.

Module ELT2030: Branch Circuit Wiring
Students demonstrate the fundamentals of branch circuit wiring used in residential/commercial buildings.

Module ELT2050: Electronic Power Supply 2
Students construct and demonstrate the fundamentals of electronic power supply technology.

Module ELT2060: Digital Technology 2
Students demonstrate knowledge of digital principles, by using small-scale transistor–transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) integrated technology.

Module ELT2070: Computer Technology
Students develop the knowledge and skills required to install and configure a disc operating system and to set up a computer network.

Module ELT2080: Control Systems 2
Students demonstrate how process control technology is used in real-world applications.

Module ELT2090: Analog Communication 2
Students demonstrate the fundamental concepts of electronic analog communication systems.

Module ELT2100: Radio Communication
Students demonstrate the fundamental concepts of electromagnetic communication systems.

Module ELT2110: Security Systems 2
Students demonstrate the fundamentals of security technology used in homes, businesses and transportation systems.

Module ELT2120: Electro Optics
Students demonstrate basic knowledge of lasers and other light wave communication applications in various electronic systems.

Module ELT2130: Magnetic Control Devices
Students demonstrate the fundamentals of electromagnetic control devices.

Module ELT2140: Robotics 2
Students demonstrate the fundamental concepts of sensor devices and control systems, by building an electronic circuit to control a direct wire or mobile robot.

Module ELT2150: Electronic Controls
Students demonstrate the fundamentals of ladder/relay logic programming, and demonstrate how the program's logic controller system operates.

Module ELT3010: Electro-assembly 3
Students apply photographic processes to construct a printed circuit for an electronic project.

Module ELT3020: Electronic Servicing
Students develop and apply basic processes and skills to service and repair consumer-based electronic products.

Module ELT3030: Power Systems & Services
Students construct, operate, analyze and evaluate various single-phase and three-phase power systems and services.

Module ELT3040: Generation/Transformation
Students operate, experiment with and analyze alternators and transformers used in power generation and distribution.

Module ELT3060: Digital Technology 3
Students demonstrate knowledge of digital principles by using medium-scale transistor–transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) integrated technology.

Module ELT3070: Digital Applications
Students experiment with large-scale and very large-scale integrated circuits, and demonstrate their applications to practical situations.

Module ELT3080: Microprocessors
Students compare the internal architecture of microprocessors and program them, using instruction sets.

Module ELT3090: Microprocessor Interface
Students demonstrate how to interface microprocessors/microcontrollers with real-world applications.

Module ELT3100: Analog Communication 3
Students demonstrate the principal concepts of electronic analog communication systems.

Module ELT3110: Amplifiers
Students demonstrate knowledge of various types and classes of amplifiers.

Module ELT3130: Data/Telemetry Systems
Students demonstrate the fundamentals of various data/telemetry systems, and demonstrate their applications to the real world.

Module ELT3140: Motors
Students demonstrate knowledge of electric motor operation and loading characteristics.

Module ELT3150: Robotics 3
Students demonstrate remote/autonomous control systems, by constructing circuits to control robotic behaviour.

Module ELT3160: Control Applications
Students demonstrate the fundamentals of programmed controls, and demonstrate how sensing devices are integrated to control output devices.

SECTION C: PLANNING FOR INSTRUCTION

CTS provides increased opportunity for junior and senior high schools to design courses based on the needs and interests of their students and the circumstances within the school and community. Some strands may be appropriately introduced at the junior high school level. Other strands are more appropriately introduced at the senior high school level or to Grade 9 students. Refer to Sample 1 and 2 in Section C for recommendations regarding Electro-Technologies strand, or the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* for a summary of the recommended grade levels for each strand.

PLANNING FOR CTS

Defining Courses

Schools determine which strands and modules will be offered in a particular school, and will combine modules into courses.

Each module was designed for approximately 25 hours of instruction. However, this time frame is only a guideline to facilitate planning. The CTS curricula are competency based, and the student may take more or less time to gain the designated competencies within each module.

A course will usually consist of modules primarily from the same strand but, where appropriate, may include modules from other CTS strands. Refer to the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* (Appendix 4) for more information on course names and course codes.

Module selection and sequencing should consider:

- prerequisite(s)
- supporting module(s) (other CTS modules that may enhance the learning opportunity if offered with the module)
- module parameters
  - instructional qualifications, if specialized
  - equipment and facility requirements, if specialized.

The module parameters are defined for each module in Sections D, E and F of this Guide.

Degree of Flexibility

The CTS program, while designed using the modular structure to facilitate flexible timetabling and instructional delivery, does not mandate the degree of flexibility a school or teacher will offer. The teacher and school will determine the degree of flexibility available to the student. Within the instructional plan established by the school, the student may:

- be given the opportunity to progress at a rate that is personally challenging
- have increased opportunity to select modules that develop competencies he or she finds most relevant.

Integrating Basic Competencies

The basic competencies relate to managing learning and resources, problem solving and innovation, communicating effectively, working with others and demonstrating responsibility are developed throughout the CTS program, and are within each module.

Assessment of student achievement on the basic competencies is integrated throughout the other module learner expectations. Refer to Section G (Assessment Tools) of this Guide for the description of student behaviours expected at each of the four developmental stages defined for the basic competencies.

Assessment of basic competencies could include input and reflection involving the student, teacher(s), peers and others. Description of the observed behaviour could be provided through a competency profile for the module. Positive, ongoing interaction between the student and teacher will support motivation for student growth and improvement.

Assessment of student achievement on the basic competencies is integrated throughout the other module learner expectations.

Assessing Student Achievement

Assessing the student's competency is a process of gathering information by way of observations of process, product and student interaction.

Where appropriate, assessment tools have been defined to assist the teacher and student in the assessment. Refer to Section G (Assessment Tools) of this Guide for copies of the various tools (worksheets, checklists, sample questions, etc.).

A suggested emphasis for each module learner expectation has also been established. The suggested emphasis is a guideline to help teachers determine time allocation and/or a percentage grade for students.

Recognizing Student Achievement

At the high school level, successful demonstration of the exit-level competencies in a module qualifies the student for one credit. Refer to Section A for more detailed information about how curriculum and assessment standards are defined in CTS. Refer to the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* (Appendix 12) for more information on how student achievement can be recognized and reported at the school and provincial levels.

Portfolios

When planning for instruction and assessment, consider a portfolio as an excellent tool to provide evidence of a student's effort, progress and achievement. Portfolios will aid students in identifying skills and interest. They also provide the receiving teacher, employer and/or post-secondary institution proof of a student's accomplishments. The make-up and evaluation of the portfolio should be a collaborative agreement between the student and teacher.

Resources

A comprehensive resource base, including print, software and audio-visual, has been identified to support the Electro-Technologies strand. It is intended that these resources form the basis of a resource centre, encouraging teachers and students to access a wide selection of resources and other information sources throughout the learning process. Unless otherwise noted, these resources are considered to be suitable for both junior and senior high school students.

Authorized resources may be obtained from the Learning Resources Distributing Centre or directly from the publisher or distributor. Refer to Section I (Learning Resource Guide) of this Guide for the complete resource list including curriculum correlations and resource annotations. Additional sources refer to noncommercial or government agencies that offer resources that may be of assistance in this strand.

Sample Student Learning Guides

In addition to the resources, Sample Student Learning Guides are available for some modules in Electro-Technologies. These samples, designed for individual student or small group use, provide an instructional plan for selected modules and include the following components:

- Why take this module?
- What are the entry-level competencies?
- What are the exit-level competencies?
- What resources may be accessed?
- What assignments/activities must be completed?
- What are the timelines?
- How will the final mark be calculated?

Sample Student Learning Guides have been developed for the following modules in Agriculture:

- ELT1010 Electro-assembly 1
- ELT1130 Robotics 1.

PLANNING FOR ELECTRO-TECHNOLOGIES

Safety

In Career and Technology Studies, health and safety are given a high priority. Teachers of Electro-Technologies program should make every effort to provide a safe environment for students. Facilitators should have knowledge of safety hazards in the program and how best to minimize accidents.

In Electro-Technologies, when student-fabricated projects involve circuitry with live (110 volts or higher) voltages, instruction must be supervised by persons with a journeyman or equivalent status. These projects must be connected, when tested, to live voltages through a ground fault interrupter (GFI) circuit breaker.

Projects may also be designed and constructed for Class 1 voltages (less than 30 volts) or simulated through the use of interactive software packages. When these delivery strategies are used, journeyman status would not be required. For specific safety concerns, refer to module parameters and specific learner expectations relating to safety.

Related Legislation

The Electro-Technologies strand delivers many of the competencies that exist in the following Alberta compulsory trade areas: Appliance Serviceman, Electrician, Electronic Technician; and some of the competencies in the following optional trade areas: Communication Electrician, Electrical Rewind Mechanic and Instrument Mechanic.

The *Alberta Apprenticeship and Industry Training Act* provides detailed explanations regarding the delivery of apprenticeship programs in Alberta. The Act specifically addresses who can or cannot work in compulsory and optional trade areas. The Act states: *A person shall not work in a compulsory or optional trade area unless that person:*

a. *holds a trade certificate*
b. *is an apprentice in the specified trade*
c. *is authorized under Section 23 to work or perform one or more tasks in the trade*
d. *is a student in a student work training program in that trade.* (Note: CTS related.)

In addition, optional certificated trades, if a person is employed by another person, that individual may work in or perform one or more tasks, activities or functions if the employer is satisfied that the person possesses the skill and knowledge in the trade as would be expected from one who would be in possession of a trade certificate.

It should be noted that the Act spells out that the ratio of journeyman to apprentices is a minimum of one apprentice to each journeyman employed. This ruling applies to Registered Apprentice students during off-campus learnings.

Instructional Qualifications

Responsibility for instructional planning and delivery of courses in Electro-Technologies will be assumed by Alberta certified teachers having expertise in classroom and electricity/electronics laboratory experience. See specific modules for detailed information regarding instructional qualifications. Note that portions of modules requiring special instructional qualifications can also be delivered through off-campus learnings. Or, projects may be accomplished using Class 1 voltages (less than 30), at which time no journeyman instructional qualifications would be required.

Selecting Modules

The scope and sequence chart in Section B provides an overview of the Electro-Technologies modules, indicating prerequistes and theme areas. Brief descriptions of the modules follow the scope and sequence chart in Section B.

The Electro-Technologies curriculum allows teachers the flexibility to design programs based on the needs and interests of their students and other mitigating factors within the school and/or community.

Electro-Technologies modules may be offered by schools as a 3-credit course, or they may be grouped together with modules from this strand or other strands for 3-, 4-, 5- or 6-credit courses.

The following groupings are samples of possible module combinations.

Sample 1

Junior High Program

Modules
ELT1010 Electro-assembly 1 ELT1030 Conversion & Distribution MEC1010 Modes & Mechanisms
Rationale/Learnings
Students understand and appreciate electrical/electronic systems and will be motivated toward further learnings. This program complements the junior high science program. It also links with other CTS strands such as Design Studies, Construction Technologies and Fabrication Studies.

Sample 2

Senior High Program

Modules
ELT1010 Electro-assembly 1 ELT1050 Electronic Power Supply 1 ELT1060 Digital Technology 1
Rationale/Learnings
The successful completion of these modules will provide students with introductory skills and knowledge in fabrication and service, power systems and computer logic systems. This program complements the high school science program units *"Understanding Technology – Electricity," "Energy and Change," "Electromagnetic Energy"* and *"Electric Forces and Fields."* This program also complements math and language arts programs as well as other CTS strands.

Modules could also be grouped according to themes, thereby accommodating special interest. Many modules may be offered in combination with service and fabrication modules to accommodate individual module project construction or with Career Transitions project modules where more challenging projects are selected requiring additional skills and time.

Organizing for Learning

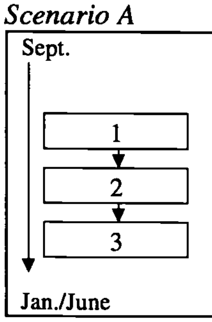
Once modules have been selected and the instructional period defined, teachers will plan how students will learn. This will involve:

- reviewing module learner expectations (MLEs) and specific learner expectations (SLEs) for each module selected
- assessing the competencies that students bring to the module and determine if a course challenge is warranted, or allow students to waive some of the activities/projects if competencies have already been acquired
- directing the students to proceed to another module if all competencies are met
- determining the level of flexibility students will have in selecting and progressing through modules
- determining the resources, including student learning guides required
- determining how basic competencies will be integrated into the program
- determining instructional strategies to be used (see *CTS Manual for Administrators, Counsellors and Teachers,* Appendix 9)
- determining how student achievement will be assessed including tools and weighting (refer to section G of this Guide).

Before selecting modules, teachers should check the module parameters outlined in each module (see Sections D, E and F of this Guide).

Modules can be delivered sequentially, concurrently or combined.

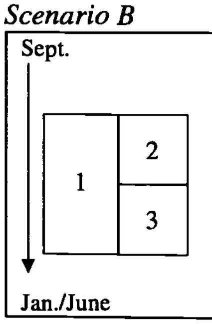
Scenario A



Modules may be taught sequentially, e.g.:

Electro-assembly 1
↓
Conversion & Distribution
↓
Electronic Power Supply 1

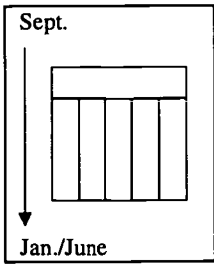
Scenario B



One module may be taught throughout the course (e.g., 20 minutes per class), in conjunction with two other modules.

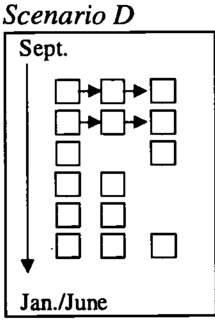
Teachers can also allow students to progress at a rate that is personally challenging; e.g.:

Scenario C



All students take one or two modules together, then are able to select modules from a menu of modules.

Scenario D



From a list of modules defined by the teacher, the students select which ones they will work on and, in consultation with the teacher, establish timelines for completion and submission of assignments, etc.

Identifying Linkages

Programs in Electro-Technologies may be designed by:

- combining modules from one or more strands (e.g., Mechanics, Design Studies, Construction Technologies, Career Transitions)
- combining modules with science programs.

Section H of this Guide describes linkages with CTS strands and with core and other complementary programs.

Project and practicum modules are **not** designed to be offered as distinct courses and should **not** be used to extend Work Experience 15, 25 and 35 courses.

Transition from High School to the Workplace and/or Related Post-secondary Programs

To assist students in making smooth transitions, consideration should be given to the development of a portfolio.

Refer to Section H of this Guide for potential transitions that students may make into:

- the workplace
- related apprenticeship programs
- related post-secondary programs or other avenues for further learnings.

MODULE CURRICULUM AND ASSESSMENT STANDARDS

SECTION D: INTRODUCTORY LEVEL

The following pages define the curriculum and assessment standards for the introductory level of Electro-Technologies.

Introductory level modules help students build daily living skills and form the basis for further learning. Introductory modules are developed for students who have no previous experience in the strand.

Module learner expectations define the competencies a student must demonstrate to achieve success in a module. Assessment standards define the criteria and conditions to be used for assessing the competencies defined in the module learner expectations.

Specific learner expectations provide a detailed framework for instruction and help students build the competencies defined in the module learner expectations. Additional information and suggestions for instruction are provided in the Notes column; teachers may wish to use this space to record their ideas for instruction or student projects.

Module ELT1010: Electro-assembly 1 .... D.3
Module ELT1030: Conversion & Distribution D.7
Module ELT1050: Electronic Power Supply 1 .... D.11
Module ELT1060: Digital Technology 1 .... D.15
Module ELT1080: Control Systems 1 .... D.19
Module ELT1090: Analog Communication 1 .... D.23
Module ELT1100: Electronic Communication D.27
Module ELT1110: Security Systems 1 .... D.31
Module ELT1130: Robotics 1 .... D.35

MODULE ELT1010: ELECTRO-ASSEMBLY 1

Level: Introductory

Theme: Fabrication and Service Principles

Prerequisite: None

Module Description: Students apply basic fabricating and servicing techniques to construct and test electronic and electromagnetic devices and cables.

Module Parameters: Basic hand tools, soldering equipment, voltmeter, ohmmeter/test light and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• apply the appropriate fabrication techniques, including proper soldering and component assembly procedures, to construct and test a simple electronic circuit	• construction of a simple electronic project and observation of: – plan of action – complexity of system/circuit function – quality of assembly – testing procedures. *Assessment Tool* *ELT1010: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 1 for each applicable task*	45
• apply the appropriate fabrication techniques to construct and test an electromagnetic device	• construction of a simple magnetic device and observation of: – circuit function – complexity of system – system/circuit testing. *Assessment Tool* *ELT1010: Assessment Checklist: Laboratory Practice, Part 2* *Standard* *Performance rating of 1 for each applicable task*	30

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MODULE ELT1010: ELECTRO-ASSEMBLY 1 (continued)

<table>
<tr><th>Module Learner Expectations</th><th>Assessment Criteria and Conditions</th><th>Suggested Emphasis</th></tr>
<tr><td>The student will:

• identify and assemble common electrical/ electronic cables and connectors used in power, audio and video connections</td><td>Assessment of student achievement should be based on:

• construction of the following:
– one soldered connection (RCA patch cord)
– one solderless connection (power extension cord)
– one communication cable connection (telephone extension cord)
– one current cable connection (crimp connected cable).

Assessment Tool
ELT1010: Assessment Checklist: Laboratory Practice, Part 3

Standard
Performance rating of 1 for each applicable task</td><td>20</td></tr>
<tr><td>• demonstrate established laboratory procedures and safe work practices</td><td>• observed performance in:
– following established laboratory procedures
– safe soldering practices
– avoiding electrical hazards.

Assessment Tool
ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices

Standard
Performance rating of 1 for each applicable task</td><td>5</td></tr>
<tr><td>• demonstrate basic competencies.</td><td>• observations of individual effort and interpersonal interaction during the learning process.

Assessment Tool
Basic Competencies Reference Guide and any assessment tools noted above</td><td>Integrated throughout</td></tr>
</table>

<table>
<tr><th>Concept</th><th>Specific Learner Expectations</th><th>Notes</th></tr>
<tr><td>Safety/Resource Management</td><td>The student should:

• demonstrate safe home/lab procedures with respect to electrical hazards and use of solder and flux

• identify and explain the importance of electrical protection devices.</td><td>

Fuses, breakers.</td></tr>
</table>

MODULE ELT1010: ELECTRO-ASSEMBLY 1 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals	• construct and analyze a simple control circuit	
	• measure voltage and continuity to appraise condition of circuit using appropriate instrumentation; e.g., simple alarm, simple automobile circuit, multimeter (digital and analog)	Techniques video.
	• define AC/DC voltages and polarity	
	• use proper solder and soldering techniques to gain an understanding of their value	Power cable, communication cable (solder and solderless).
	• install specialty connectors and cables to acquire knowledge and skills	
	• demonstrate an understanding of specialty cables that link systems with special functions including fibre optics, coaxial, telephone	
	• identify components.	Resistor and capacitor identification.
Designing and Prototyping	• analyze several magnetic devices to formulate an understanding of their function; e.g., speakers, electromagnetic crane, tape heads, moving magnetic pick-ups, relays, magnetic strip, levitation trains, magnetic device in hard drive	
	• use various breadboarding techniques to be able to understand methods used; e.g., nail and board sector and spring clip, wire wrap, point to point and solderless breadboard.	

MODULE ELT1030:	**CONVERSION & DISTRIBUTION**
Level:	Introductory
Theme:	Power Systems
Prerequisite:	None
Module Description:	Students experiment and work with principles of electrical energy conversion and distribution.

Module Parameters: Basic hand tools, multimeter and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe methods of converting nonrenewable and renewable sources of energy into electricity	• identification and description of six ways of converting energy into electricity in Alberta. *Assessment Tool* *ELT1030–1: Project Assessment: Electrical Energy Conversion and Distribution* *Standard* *Performance rating of 1 for each applicable task*	5
• construct an electrical distribution system	• construction of an electrical distribution system that includes: – source, load, wiring and control devices – series/parallel and combination circuits. *Assessment Tool* *ELT1030–1: Project Assessment: Electrical Energy Conversion and Distribution* *Standard* *Performance rating of 1 for each applicable task*	40

MODULE ELT1030: CONVERSION & DISTRIBUTION (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate how mechanical, chemical, light and heat energy can be converted into electrical energy	• prototyping and operating any two energy conversion systems: – comparing outputs of the two sources – working cooperatively with others. *Assessment Tool* *ELT1030–1: Electrical Energy Conversion and Distribution* *Standard* *Performance rating of 1 for each applicable task*	30
• determine the cost efficiency, practicality and environmental impact of producing electricity from various sources of energy	• presentation of an oral or written report that identifies cost efficiency, practicality and the environmental impact of providing energy from one or more renewable and nonrenewable energy sources. *Assessment Tool* *ELT1030–1: Electrical Energy Conversion and Distribution* *Standard* *Performance rating of 1 for each applicable task*	20
• demonstrate established laboratory procedures and safe work practices	• observed performance related to following: – established laboratory procedures – safe work practices pertaining to high voltages. *Assessment Tool* *ELT1030–1: Electrical Energy Conversion and Distribution* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

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MODULE ELT1030: CONVERSION & DISTRIBUTION (continued)

Concept	Specific Learner Expectations	Notes
Safety	*The student should:* • identify and follow safety procedures in home/laboratory.	Describe hazards of working with high voltages.
Designing and Prototyping	• build and/or operate one energy conversion system that produces electricity using chemical, light, heat and/or mechanical energy forms.	Have students produce electricity using: • lemon • potato • photo/solar cell • crystals • thermocouple • generator.
System Identification	• identify and describe how energy is converted into electricity in a: – wet/dry cell – photovoltaic cell – thermocouple – generator/alternator – piezoelectrical crystal • describe electrical power distribution systems from source to consumer • research issues related to electrical generation, transmission and distribution systems, e.g.: – cost efficiencies – environmental impact of fossil fuel, hydro electric and nuclear power plants – conventional (fossil fuel) versus nonconventional (tidal, solar, wind) sources.	
Real-world Application	• report on issues related to energy efficiency and conservation • identify specific applications of energy conversion used in personal life.	Bicycle generator, solar panel, wind generator, gas generator.
Fabricating/Testing	• wire common lighting and communication circuits: – breadboarding (low voltage) – switches, lights, plugs, bells, buzzers, etc. • test circuits for continuity and function.	*Basic Wiring* (Creative Homeowner Press, 1994). Use a variety of load and control devices.

Concept	Specific Learner Expectations	Notes
Careers	*The student should:* • explain employment opportunities in electrical generation and distribution.	Tour substations and/or view videos. *Apprenticeship and Industry Training Act.*

MODULE ELT1050: ELECTRONIC POWER SUPPLY 1

Level: Introductory

Theme: Power Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students construct different types of alternating and direct current power supplies, and demonstrate their application in electrical/electronic systems.

Module Parameters: Basic hand tools, multimeter and related resources; direct teacher supervision for line voltage connections.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe various types of alternating and direct current power supplies	• an oral or written report that: – distinguishes between voltage, current and power ratings and between various AC and DC power supplies – describes power supply ratings – describes the configuration of a rectifier. *Assessment Tool* *ELT1050–1: Presentations/Reports: Power Supplies* *Standard* *Performance rating of 1 for each applicable task*	20
• construct a simple power supply	• observed performance when identifying, designing and constructing a power supply for a: – battery tester – battery eliminator – battery charger. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 3 and 4* *Standard* *Performance rating of 1 for each applicable task*	55

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• test a regulated, filtered power supply for output characteristics	• accurate measurement of power supply characteristics using a multimeter. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 4* *Standard* *Performance rating of 1 for each applicable task*	20
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – grounding precautions – proper handling of high voltage current devices. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate a positive attitude of personal safety • identify, locate and use proper personal protective equipment.	Demonstrate proper grounding of high voltage and current devices. Use only Canadian Standards Association (CSA) approved equipment.

MODULE ELT1050: ELECTRONIC POWER SUPPLY 1 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
System Identification	• distinguish and describe voltage, current and power ratings on a power supply • describe AC and DC power supplies • distinguish between various power supplies, such as transformers, inverters, converters, eliminators, battery, solar, voltage doubler, voltage tripler • identify stages of a power supply in transformer, rectifier, filter and regulator • appraise the merits and deficiencies of half wave, full wave bridge and centre tap rectifiers.	Investigate television, radio, stereo and appliance ratings. Simple, AC/DC power supplies, battery tester, battery eliminator, battery charger.
Fabricating/Testing	• construct simple power supplies, using perforated circuit board • measure power supply output using a multimeter.	Simple, AC/DC power supplies, battery tester, battery eliminator, battery charger. Measuring voltage and current.

MODULE ELT1060: DIGITAL TECHNOLOGY 1

Level: Introductory

Theme: Computer Logic Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students construct and demonstrate logic systems and their unique functions.

Module Parameters: Five-volt power supply, logic probe and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the binary numbering system and logic gates	• observed performance related to: – identifying and converting binary and base 2, 8 and 16 numbering systems – identifying the symbols for basic logic gates – stating the function of basic logic gates – writing a truth table for a logic gate circuit. *Assessment Tool* *ELT1060–1: Presentations/Reports: Binary Numbering System* *Standard* *Performance rating of 1 for each applicable task*	20
• construct and verify basic logic gates	• observed performance when constructing a binary logic circuit and verifying it with a truth chart using a logic probe. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice* *Standard* *Performance rating of 1 for each applicable task*	35
• construct a simple logic circuit, and explain its functions	• observed performance using logic gates or hardwired contact to solve a design problem. *Assessment Tool* *ELT1060–1: Presentations/Reports: Binary Numbering System* *Standard* *Performance rating of 1 for each applicable task*	35

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify the major integrated circuit (IC) families, and describe their unique functions	• identifying and knowing the function of selected integrated circuit (IC) families. *Assessment Tool* *ELT1060–1: Presentations/Reports: Binary Numbering System* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – when and how to perform electrostatic discharge. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• identify and follow laboratory safety procedures • explain how to avoid electrostatic discharges around IC chips • demonstrate an understanding of grounding, voltage and current rating of various IC families.	Grounding, power supplies.

Concept	Specific Learner Expectations	Notes
	The student should:	
System Identification	• distinguish between analog and digital systems • identify major component sections of a logic system, such as: – random access memory (RAM) – read only memory (ROM) – central processing unit (CPU) – registers – input/output (I/O) ports	
	• identify the application, pinouts and use of various IC chips from manufacturing codes	TTL, CMOS, DTL , RTL, MOS.
	• identify characteristics of various IC chips from different manufacturers which do similar functions using ECG, NTE and other replacement guides • identify the pinouts and function of any IC using the IC master reference texts	Refer to *Semiconductor Reference Handbook.* Note: Many replacement guides are produced for computers in CD ROMs.
	• identify the difference between various logic families • identify/explain differences between various logic systems	
	• use a digital probe.	Digital displays, password strips, combination locks, security controls, counters, digital multimeters.
Fundamentals	• develop the circuits and tables for the following logic gates: – AND – OR – NOT – X-OR – NAND – NOR – XNOR, etc.	
Fabricating/Testing	• construct digital probes • test digital probes.	Logic probe kit or perforated board.

Concept	Specific Learner Expectations	Notes
Designing and Prototyping	*The student should:* • breadboard a digital system, such as combination locks and keyboard • use emulation software; e.g., electronics workbench.	
Problem Solving	• solve a digital problem and build a digital system for a solution (two or three inputs for a single output).	Two input gates to make a three-input gate.
Careers	• research areas of certification: – trade certification – vendor certification – professional associations – equipment standards.	

MODULE ELT1080: CONTROL SYSTEMS 1

Level: Introductory

Theme: Computer Logic Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students construct process control systems, demonstrate their basic operation, and demonstrate procedures for testing them.

Module Parameters: Digital/analog multimeters, pressure devices and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify how control systems are used in residential and commercial applications	• listing and describing four different control systems used in home and industrial settings. *Assessment Tool* *ELT1080–1: Presentations/Reports: Control Systems* *Standard* *Performance rating of 1 for each applicable task*	15
• identify basic process control systems, and explain how they function	• describing basic process control systems including open and closed-loop systems. *Assessment Tool* *ELT1080–1: Presentations/Reports: Control Systems* *Standard* *Performance rating of 1 on each criteria*	15
• construct basic process control circuits, using passive devices	• observed performance when constructing and testing a system using four passive devices. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 3 and 4* *Standard* *Performance rating of 1 on each criteria*	65

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate established laboratory procedures and safe work practices	*Assessment of student achievement should be based on:* • observed performance in following: – established laboratory procedures – safe and correct procedures in measuring voltage, current and resistance. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • demonstrate safe and correct procedures in measuring voltage, current and resistance using digital and analog meters.	
Fundamentals	• draw and explain a process control system using block diagrams depicting each functional component and the flow of signals through the systems • explain the difference between open-loop and closed-loop control systems	Use any control system found in a home or car; e.g., • car thermostat • home thermostat • fuel quantity measurement • coolant temperature measurement.

MODULE ELT1080: CONTROL SYSTEMS 1 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals (continued)	• explain process control terms: – precision – standard – calibration – accuracy – sensor – transducers – distortion – transients – sampling – interrupt – frequency	
	• demonstrate knowledge in measuring voltage, current and resistance in any control system using analog and digital instruments.	Use digital/analog multimeters.
Fabricating/Testing	• construct a basic process control system using passive devices, such as: – thermistor – pressure sensor – proximity switch – light control resistor – float switch – reed switch – photo cell.	
	• explain how to test process control circuit(s), voltage, current, continuity, opens, shorts.	Use analog and digital meters.

MODULE ELT1090: ANALOG COMMUNICATION 1

Level: Introductory

Theme: Communication Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students install and demonstrate the fundamentals of various consumer audio integrated systems.

Module Parameters: Consumer audio or automobile systems, multimeters and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• distinguish the difference between terms and specifications used in analog audio systems	• the ability to distinguish the difference between terms and specifications such as: – wattage – peak value – sine waves – distortion – impedance matching. *Assessment Tool* *ELT1090–1: Presentations/Reports: Analog Audio* *Standard* *Performance rating of 1 for each applicable task*	15
• install a functional audio system according to a given set of specifications	• observance of performance in installing an audio system. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 3 and 4* *Standard* *Performance rating of 1 for each applicable task*	50

MODULE ELT1090: ANALOG COMMUNICATION 1 (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • service and maintain a consumer audio system	*Assessment of student achievement should be based on:* • observed performance related to: – identifying problems – cleaning and adjusting components – correcting faults. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 5* *Standard* *Performance rating of 1 for each applicable task*	30
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – procedures regarding high current and heat – correct wiring procedures and use of current protection. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • identify causes of high current and high heat in systems • follow correct wiring procedures.	Fusing, load-carrying capacity of cables, temperatures, heat dissipation.

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals	• read and interpret an audio system flow connection chart. • define audio terms and specifications such as wattage, peak value, sine waves, distortion, impedance matching.	
System Identification	• identify various subsystems of an audio system, including: – amplifier – preamp – equalizer – speakers – compact disc player – tape – crossover. • identify major components of an amplifier through the use of block diagram, identifying power supply, preamp, amplifier.	
System Application	• install a complete audio system.	Expand to power speakers, equalizers, distribution system.
Fabricating/Testing	• construct a simple audio device, such as: – amplifier – crossover network – fader – equalizer – distribution network – mixers – light organ • explain and demonstrate how to test an audio device for intended function.	Consider the possibility of linking this module with ELT2010 Electro-assembly 2.
Problem Solving	• lay out and connect the wiring for an audio system.	Solderless versus solder connections, terminal blocks, fusing, grounding, filtering.

MODULE ELT1090: ANALOG COMMUNICATION 1 (continued)

Concept	Specific Learner Expectations	Notes
Repair/Service and Maintenance	*The student should:* • explain and demonstrate how to troubleshoot an audio system. • maintain an audio system by identifying problems and correcting.	Clean heads, antenna tuning, poor connections, cleaning volume controls. Check if cost effective.

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MODULE ELT1100: ELECTRONIC COMMUNICATION

Level: Introductory

Theme: Communication Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students demonstrate the fundamentals of video systems, and describe their uses.

Module Parameters: Special video equipment, cables, connectors and resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and compare the operating principles of coaxial cable television (CCTV) and cable television (CATV) video systems	• explanation of the operating principles of the following video systems: – closed circuit television (CCTV) – cable television (CATV). *Assessment Tool* *ELT1100–1: Presentations/Reports: Video Systems* *Standard* *Performance rating of 1 for each applicable task*	25
• describe and compare various video formats	• differentiate between: – VHS – Beta – 8 mm video formats. *Assessment Tool* *ELT1100–1: Presentations/Reports: Video Systems* *Standard* *Performance rating of 1 for each applicable task*	20
• assemble and install connectors associated with video cable network and video electronic systems	• observation of performance when connecting: – camera to recorder – recorder to television – camera/recorder to cable network – computer to cable network – camera or video cassette recorder to computer. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 3 and 4* *Standard* *Performance rating of 1 for each applicable task*	30

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain the operation of an analog-modulated video system	• explanation of the operating principles of a given analog-modulated video system. *Assessment Tool* *ELT1100–1: Presentations/Reports: Video Systems* *Standard* *Performance rating of 1 for each applicable task*	20
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – proper procedures for handling of CRTs – correct procedures when working with static and magnetic sensitive subsystems. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• follow laboratory safety procedures, in particular when handling cathode-ray tube (CRT), laser fibre optics, cable connections, vibration-sensitive mounting and static and magnetic sensitive subsystems.	Use of static straps.

Concept	Specific Learner Expectations	Notes
Fundamentals	*The student should:* • define terms used in video network systems: – video signal – frequency modulation (FM) – video home system (VHS) – Beta – 8 mm – video graphics array (VGA) – closed circuit television (CCTV) – cable television (CATV) – digital modulation – bandwidth – channels – digital pulse modulation – impedance matching.	Explain the difference between RF connectors such as "F," BNC, UHF, TNC.
System Identification	• identify CCTV and CATV video systems • explain the block diagram of the following photo-visual systems: slide, film (8, 16, 32, 70 mm) • differentiate between VHS, Beta, 8 mm, CD video formats.	
System Application	• connect a camera to a recorder • connect a recorder to a TV • connect a camera/recorder to a cable network system • connect a computer to a cable network • connect a video system to minimize video loss (impedance matching) • explain operation of distribution amplifiers. • connect cables according to industry standards.	
Problem Solving	• identify the impedance of different coaxial cables • examine the impedance matching characteristics of different types of cables.	
Ethics	• identify ethical points of view when taking signals from video systems.	

MODULE ELT1110: SECURITY SYSTEMS 1

Level: Introductory

Theme: Communication Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students install and demonstrate the fundamentals of sensors, control units and warning devices used in security systems.

Module Parameters: Specialized equipment.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and compare different electronic systems used to secure people, property and information	• identification and comparison of security systems used to secure: – people – property – information. *Assessment Tool* *ELT1110–1: Presentations/Reports: Security Systems* *Standard* *Performance rating of 1 on each criteria*	5
• describe and compare hardwired sensors	• comparing and describing the following security system sensors: – contact closure – motion sensor – thermal sensor – moisture sensor – light sensor. *Assessment Tool* *ELT1110–1: Presentations/Reports: Security Systems* *Standard* *Performance rating of 1 on each criteria*	35

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Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• install and test a security system, evaluate circuit performance, and identify possible maintenance requirements	• observation of performance when installing a security system • testing and validating circuit performance using voltmeter or continuity tester • explaining and maintaining various security systems. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 3 and 4* *Standard* *Performance rating of 1 on each criteria*	55
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – personal safety precautions. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 1 on each criteria*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • demonstrate appropriate attitudes of personal safety.	

MODULE ELT1110: SECURITY SYSTEMS 1 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
System Identification	• distinguish between different types of security systems; e.g., monitored, standalone, closed circuit, automobile, personal • distinguish between various security devices; e.g., computer systems, hardwire, remote frequency system • demonstrate how to inspect various sensors; e.g., contact closure, motion, thermal, moisture detectors • demonstrate how to inspect various warning devices; e.g., dialer, siren, lights.	
System Application	• explain and demonstrate how to install a security system.	Home or auto security system.
Problem Solving	• demonstrate how to test and validate circuit performance using voltmeter or continuity tester.	
Repair/Service and Maintenance	• explain/maintain various security systems.	Battery testing, performance, reliability, stress testing, sensitivity testing.
Careers	• research careers in the security realm. • research areas of certification of installers and equipment • identify ethical points of view in using personal security systems.	Be aware of possible negative implications.

MODULE ELT1130: ROBOTICS 1

Level: Introductory

Theme: Robotic and Control Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students apply the fundamentals of robotic systems and basic robotic functions.

Module Parameters: No specialized equipment or facilities.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the evolution and applications of robotic systems	• description of trends and evolution of robotic system. *Assessment Tool* *ELT1130–1: Presentations/Reports: Robots* *Standard* *Performance rating of 1 for each applicable task*	15
• identify and classify robotic systems and subsystems	• identifying and classifying robotic systems and subsystems. *Assessment Tool* *ELT1130–1: Presentations/Reports: Robots* *Standard* *Performance rating of 1 for each applicable task*	15
• design and build a direct control robotic system	• observation of performance on designing and building a direct wire robotic system. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 3 and 4* *Standard* *Performance rating of 1 for each applicable task*	65

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate established laboratory procedures and safe work practices	*Assessment of student achievement should be based on:* • observed performance in following: – established laboratory procedures pertaining to robotics. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 1 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • follow laboratory safety procedures • adhere to safe equipment practices and personal protection.	
System Identification	• distinguish between various robotic geometric systems. • distinguish between subsystems and their applications.	Power supply, actuators, sensors, program, CPU drivers.
Designing and Prototyping	• prototype a direct control robotic unit to illustrate the: – use of computer-aided design (CAD) – hydraulic, pneumatic and electromechanical interfacing – cumulative serial and parallel operations.	Note: Link with MEC1010: Modes & Mechanisms.

Concept	Specific Learner Expectations	Notes
Fundamentals	*The student should:* • demonstrate an understanding of AC/DC motor controls to include switching motor states.	
Problem Solving	• identify problem/task for robotic system • demonstrate operation of a robot through its predetermined set of functions.	Difference between coded and uncoded control.

MODULE CURRICULUM AND ASSESSMENT STANDARDS: SECTION E: INTERMEDIATE LEVEL

The following pages define the curriculum and assessment standards for the intermediate level of Electro-Technologies.

> Intermediate level modules help students build on the competencies developed at the introductory level and focus on developing more complex competencies. They provide a broader perspective, helping students recognize the wide range of related career opportunities available within the strand.

Module ELT2010: Electro-assembly 2 .... E.3
Module ELT2020: Electrical Servicing E.7
Module ELT2030: Branch Circuit Wiring E.11
Module ELT2050: Electronic Power Supply 2 .... E.15
Module ELT2060: Digital Technology 2 .... E.19
Module ELT2070: Computer Technology E.23
Module ELT2080: Control Systems 2 .... E.29
Module ELT2090: Analog Communication 2 .... E.35
Module ELT2100: Radio Communication E.39
Module ELT2110: Security Systems 2 .... E.45
Module ELT2120: Electro-optics E.51
Module ELT2130: Magnetic Control Devices E.55
Module ELT2140: Robotics 2 .... E.59
Module ELT2150: Electronic Controls E.63

MODULE ELT2010:	**ELECTRO-ASSEMBLY 2**
Level:	Intermediate
Theme:	Fabrication and Service Principles
Prerequisite:	ELT1010 Electro-assembly 1
Module Description:	Students apply electro-assembly technology to manufacture circuit boards.

Module Parameters: Printed circuit fabrication kit and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify appropriate construction methods to fabricate a circuit board	• identifying and describing the three methods to prepare an electronic circuit board for etching. *Assessment Tool* *ELT2010–1: Presentations/Reports: Circuit Boards* *Standard* *Performance rating of 2 for each applicable task*	10
• lay out and construct a simple electronic circuit board, using approved construction techniques	• identifying, designing and drawing the circuit board foil layout and constructing electronic circuit boards. *Assessment Tool* *ELTPAF: Project Assessment Form* *Standard* *Performance rating of 2 for each applicable task*	35
• use a PC board and proper fabrication techniques to assemble a project	• cleaning, drilling, mounting, soldering components, applying protective coating to foil and assembling a printed circuit (PC) board project. *Assessment Tool* *ELTPAF: Project Assessment Form* *Standard* *Performance rating of 2 for each applicable task*	50

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate established laboratory procedures and safe work practices	*Assessment of student achievement should be based on:* • observed performance in following: – established laboratory procedures – use and disposal of chemicals related to circuit board construction – use of solder and fluxes. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• research illnesses caused by chemical, solder and flux used in prototype construction • demonstrate appropriate safety techniques when using solder and chemicals for prototype construction • identify and follow safe home/laboratory procedures while using solder, flux, photochemicals, cleaning chemicals and etching chemicals.	Observe WHMIS regulations when using solder, flux chemicals, and PCB board materials.
Fundamentals	• research the benefits and drawbacks of prototype construction assembly methods.	List and explain the differences between various prototype assembly methods.

Concept	Specific Learner Expectations	Notes
	The student should:	
System Identification	• use schematic symbols to represent electronic components • draw and/or modify schematic diagrams for a simple electronic circuit • match actual components to schematic symbols.	IEEE standards. *Electronic workbench*, project books/ magazines
Designing and Prototyping	• prototype an electronic circuit on a breadboard • create the artwork circuit layout drawing for a printed circuit board • practise printed circuit board building and component installation.	Circuit on SK10 breadboard, matrix board with pins, wire wrap boards, nail and wood board, printed circuit board.
Fabrication	• use an etch-resistance pen or photographic method to make a circuit board project.	Students to research circuit work required in other ELT modules; e.g.: • Robotics modules • Communication Systems modules • Power Systems modules • Computer Logic Systems modules.
Problem Solving	• evaluate the circuit using electronic instruments • demonstrate how to troubleshoot an electronic circuit board.	Continuity check.
Careers	• research employment opportunities in photographic and breadboard circuit design and construction • maintain a record of completed activities within a portfolio or create and/or add information to an existing portfolio.	

MODULE ELT2020: ELECTRICAL SERVICING

Level: Intermediate

Theme: Fabrication and Service Principles

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students demonstrate the fundamental concepts of repairing, servicing and maintaining electrical and electronic equipment.

Module Parameters: Basic hand tools, testing equipment and related resources.

Supporting Module: ELT2010 Electro-assembly 2

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• develop a basic repair and maintenance schedule for an electrical/electronic device	• preparation of a service schedule for an electrical/electronic system, including: – basic information – factors to consider. *Assessment Tool* *ELTCSR: Customer Service, Part 3* *Standard* *Performance rating of 2 for each applicable task*	30
• identify faults in an electrical/electronic device, and propose solutions for repair	• identifying the failure of an electrical/electronic device, and providing a repair/replacement solution and cost estimate. *Assessment Tool* *ELTCSR: Customer Service, Part 4* *Standard* *Performance rating of 2 for each applicable task*	20
• use appropriate testing procedures to assess/repair an electrical/electronic device	• testing and repairing an electronic/electrical device. *Assessment Tool* *ELTCSR: Customer Service, Parts 2, 3 and 4* *Standard* *Performance rating of 2 for each applicable task*	45

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate established laboratory procedures and safe work practices	*Assessment of student achievement should be based on:* • observed performance in following: – established laboratory procedures – electrical grounding – current protection – static protection. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • demonstrate a professional attitude of personal safety • use proper grounding techniques, current protection and static protection when testing electronic circuits.	Fusing, grounding, ground fault, static grounding. WHMIS, soldering chemicals.
Fundamentals	• define current, resistance, magnetic field, voltage rating, temperature and wattage.	
System Identification	• identify the types of data found on a name plate • explain why the Canadian Standards Association (CSA) standards are applied to appliances • identify stages of operation of various types of electrical/electronic systems • interpret a flow connection chart or wiring schematic of the system.	Have students locate CSA approval stickers.

Concept	Specific Learner Expectations	Notes
Problem Solving	*The student should:* • describe standard procedures to locate circuit/component faults • identify the problem and propose a solution to effect the repair.	
Testing	• use measurement techniques related to voltage, current, resistance, wattage and continuity to appraise the condition of the circuit.	
Repair/Service/ Maintenance	• troubleshoot an electrical/electronic device • create a service schedule, considering: – nameplate data – stages of operation – charts and wiring schematics – grounding techniques – protection devices; the schedule should also reflect the following variables: – function of the unit – frequency of use – subjected conditions – age – cost of service – cost of replacement service/maintain and repair electrical/electronic devices identifying potential problems and correcting	Repair to printed circuit boards, electrical heating element appliance, motor appliance, incandescent and florescent light equipment, troubleshooting electrical house wiring, small radios.
Repair/Service/ Maintenance (continued)	• explain and demonstrate how to repair electronic printed circuit boards • measure the voltage, current and wattage of repaired items and compare the values with the nameplate ratings.	
Careers	• research employment opportunities in small appliance repair • create and/or add information to an existing portfolio.	Apprenticeship. Appliance technicians.

MODULE ELT2030: BRANCH CIRCUIT WIRING

Level: Intermediate

Theme: Power Systems

Prerequisite: ELT1030 Conversion & Distribution

Module Description: Students demonstrate the fundamentals of branch circuit wiring used in residential/commercial buildings.

Module Parameters: Basic hand tools, multimeter and related resources.

Note: The student must have access to instruction from an individual with journeyman qualification when projects are hardwired to main power supply and for permanent usage.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe various branch wiring systems used in residential and commercial applications	• using the proper pictorial schematic, line diagram, ladder diagram, terminal connection and bill of materials to show how a branch wiring system is installed according to the Canadian Electrical Code (CEC). *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 1 and 2* *Standard* *Performance rating of 2 for each applicable task*	15
• apply Canadian Electrical Code (CEC) standards to various branch wiring system designs	• installing and wiring an electrical system using the proper CEC codes for wiring: – receptacles – switching – lighting – wiring. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 2 for each applicable task*	15
• wire a branch circuit for a residential application	• application of the CEC standards when constructing a branch circuit. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 1* *Standard* *Performance rating of 2 for each applicable task*	65

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate established laboratory procedures and safe work practices	*Assessment of student achievement should be based on:* • observed performance in following: – established laboratory procedures – CEC code practices – grounding and overload protection practices – lockout/tag out practices – treatment for electrical shocks and burns. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • demonstrate how to connect wiring to comply with CEC, local and Alberta standards • demonstrate safe practices regarding grounding and overload protection of circuits and devices, such as case/receptacle grounding • describe danger of electrical shocks and burns • describe lock out/tag out practices.	Live voltage projects must be activated through GFI circuit breaker. When instructional journeyman qualifications restrict high voltage use, projects may be done in low voltages (less than 30 volts).

Concept	Specific Learner Expectations	Notes
Fundamentals	*The student should:* • use CEC standards in branch circuit design and installation • draw schematic and pictorial diagrams of branch circuit wiring • interpret architectural drawings regarding branch circuit wiring • identify various wiring systems, methods and materials; e.g.: – nonmetallic shielded cable (NMSC) – armoured cable (BX) – conduit and conductors – Teck cable – raceway systems – mineral insulated cable (Pyrotenex) – wire mold.	
System Identification	• compare series and parallel branch wiring circuits • identify live, grounding, grounded branch circuit conductors • measure voltage, current and continuity.	Live – black (hot); grounded – white (neutral); grounding – green (bare).
Fabricating/Testing	• construct, according to CEC standards, the following branch circuits in NMSC: – standard receptacle – single location lamp switching – switch receptacle – range and/or dryer receptacle – split receptacle – multiple locations lamp switching – ground-fault interrupter (GFI) receptacle • construct, according to CEC standards, one of the above branch circuits using: – armoured cable – conduit raceway • install breakers and terminate branch circuit wiring in single-phase panel board.	Dimmer switch, lamp fixtures. Standard house panel including explanations of protection function.

MODULE ELT2030: BRANCH CIRCUIT WIRING (continued)

Concept	Specific Learner Expectations	Notes
Real-world Applications	*The student should:* • research requirements for obtaining an electrical permit.	
Careers	• research Alberta apprenticeship related to electrical work • research Interprovincial and Master Certification • create and/or add information to an existing portfolio.	

MODULE ELT2050: ELECTRONIC POWER SUPPLY 2

Level: Intermediate

Theme: Power Systems

Prerequisite: ELT1050 Electronic Power Supply 1

Module Description: Students construct and demonstrate the fundamentals of electronic power supply technology.

Module Parameters: Oscilloscope, multimeter, isolation transformer and related resources.

Supporting Module: ELT2010 Electro-assembly 2

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• construct, analyze and evaluate single-phase rectifiers	• constructing, analyzing and evaluating various single-phase rectifier systems such as: – half-wave rectifier circuit – two-diode rectifier circuit – bridge rectifier circuit. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 2 for each applicable task*	25
• observe and test the voltage and waveform of a switching power supply	• identification of components and circuits using a schematic diagram and testing the voltage and waveform of a switching power supply. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 3* *Standard* *Performance rating of 2 for each applicable task*	10
• build and analyze the characteristics of a power supply regulated by a zener transistor	• identifying components/circuits using a schematic then building and analyzing a regulated power supply. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 2* *Standard* *Performance rating of 2 for each applicable task*	30

MODULE ELT2050: ELECTRONIC POWER SUPPLY 2 (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• build, test and analyze filtering circuits used in electronic power supplies	• identifying components/circuits using a schematic then building and analyzing an electronic regulated power supply filter circuits. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 2* *Standard* *Performance rating of 2 for each applicable task*	30
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – correct procedures for grounding and use of oscilloscope. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • use an isolation transformer • demonstrate safe practices, especially regarding grounding and use of oscilloscope.	

MODULE ELT2050: ELECTRONIC POWER SUPPLY 2 (continued)

Concept	Specific Learner Expectations	Notes
Fundamentals	*The student should:* • identify components responsible for improved output of a regulated filtered power supply • explain fundamentals of diodes, zeners, transistors and operational amplifiers (OP amps) • diagram half-wave, full-wave bridge and centre tap rectifiers • identify current path in half-wave, full-wave bridge, and centre tap rectifiers.	
Applied Mathematics	• mathematically analyze output voltage, ripple frequency and required peak inverse voltage of half-wave, full-wave bridge and centre tap rectifiers • mathematically determine component values for construction of a regulated power supply.	Introductory trigonometry. Introductory algebra.
Designing and Prototyping	• construct, energize, measure and graph the input and output of a half-wave, full-wave bridge, centre tap rectifiers and regulated power supply.	Permanent construction on PC board made in ELT2010. Zener, IC, op-amps, transistor regulated.
Stages of Operation	• set up, test and analyze a switching power supply.	Test existing power supply.
Fabricating/Testing	• construct a full-wave, filtered and regulated power supply • test regulated power supply.	Can be linked to Electro-assembly 3 (ELT3010).

MODULE ELT2060: DIGITAL TECHNOLOGY 2

Level: Intermediate

Theme: Computer Logic Systems

Prerequisites: ELT1060 Digital Technology 1
ELT2010 Electro-assembly 2

Module Description: Students demonstrate knowledge of digital principles, by using small-scale transistor–transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) integrated technology.

Module Parameters: Digital logic trainer, oscilloscope, function generator and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify and interface components with TTL and CMOS small-scale integration integrated circuit (IC) families	*Assessment of student achievement should be based on:* • use TTL and CMOS small-scale integrated technology ICs to: – identify the IC by number on the case and identify the family it belongs to using data manuals, CD ROMs, data programs – identify the pinouts concerning ground and voltage of both TTL and CMOS ICs using data manuals or CD ROMs, data programs – experiment with both CMOS and TTL ICs involving AND, NAND, NOR, OR, X-NOR, NOT gates using computer simulation or logic trainers – interface between various TTL and CMOS ICs – develop boolean expressions for all basic gates used in TTL and CMOS technology – develop truth tables for basic gates used in both TTL and CMOS ICs – explain various numbering systems and binary codes. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 2 for each applicable task*	40

MODULE ELT2060: DIGITAL TECHNOLOGY 2 (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify components and construct a prototype of typical small-scale and complex logic networks, using TTL and CMOS families of ICs	• given both TTL and CMOS small scale and complex logic networks, the student will: – identify each according to gate function, type of Flip-Flop or counter or register according to number system and data reference manuals or computer programs – experiment with various gates connected into a logic network (actual or computer simulation) – develop boolean expression for gate networks – demonstrate simplification of boolean expressions, gate minimization, Karnaugh mapping – experiment with devices such as registers, decoders, converters, multiplexes, etc. • using small-scale logic networks, prototype the solution using digital logic circuits in combination and sequential logic design – construct and fabricate the circuit. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 1 and 2* *Standard* *Performance rating of 2 for each applicable task*	55
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – correct procedures when working with electrostatic charges and grounding straps – recommended voltage and current rating of IC families. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

MODULE ELT2060: DIGITAL TECHNOLOGY 2 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• explain and demonstrate how to avoid electrostatic discharges around IC chips, using static mats, grounding straps • demonstrate an understanding of grounding, voltage and current rating of various IC families.	Grounding, VCC, VDD, VSS, positive and negative voltages.
Fundamentals	• explain the difference between various gate applications, counters and registers • distinguish the difference among various numbering systems and binary codes, such as: – binary – octual – hexadecimal – Binary Coded Decimal (BCD) – American Code for Information Interchange (ASCII).	Demonstrate the use of: • Flip-Flops • JK • RS • D Type • T Type.
Real-world Applications	• solve, construct and experiment with real-world problems using combination and sequential logic design for applications such as traffic lights, aircraft landing gear and motor controls • prototype the solution for a logic problem on a breadboard and develop a truth table • use emulation software on a design problem.	*Electronic workbench.*
Applied Mathematics	• demonstrate the use of boolean algebra to analyze a logic circuit.	DeMorgan's theorems. Boolean expressions for gate networks. Simplification of boolean expressions. Gate minimization. Karnaugh mapping.

Concept	Specific Learner Expectations	Notes
Designing and Prototyping	*The student should:* • demonstrate how to prototype and troubleshoot the following fundamental logic gates in typical and complex logic networks: – AND – NAND – NOR – X-NOR – OR, Registers – F/F counters – simple comparators.	
Fabricating/Testing	• use a printed circuit board (PC board) to fabricate a digital circuitry project, such as: – digital dice – sound generator decision maker – electronic scoreboard – IC tester • use a PC board software to layout a digital circuit.	

MODULE ELT2070: COMPUTER TECHNOLOGY

Level: Intermediate

Theme: Computer Logic Systems

Prerequisite: ELT2060 Digital Technology 2

Module Description: Students develop the knowledge and skills required to install and configure a disc operating system and to set up a computer network.

Module Parameters: A working computer, modem, printer, cables, software, basic hand tools and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • disassemble/assemble a working computer, and perform basic troubleshooting procedures	*Assessment of student achievement should be based on:* • identifying the various subsystems of a computer • dissembling a computer into its subsystems • assembling a computer from the above parts • setting the system configurations switches • installing monitor/keyboard • demonstrating basic computer troubleshooting techniques • demonstrating consumer maintenance • reformatting a hard disk drive. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 2, 3 and 4* *Standard* *Performance rating of 2 for each applicable task*	30

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and explain computer system components	• given a computer system board, explain the following: – central processing unit (CPU) – arithmetic logic unit (ALU) – instruction set – instruction cycle – RAM, EPROM, ROM – expansion boards – serial and parallel ports – multi, input/output option adapter cards – explain the operation of a computer system board's internal architecture. *Assessment Tool* *ELT2070–1: Presentations/Reports: Computer Systems* *Standard* *Performance rating of 2 for each applicable task*	25

• install and configure a disk operating system	• performing the following tasks:
	– use a disk operating system user's guide
	– install a disk operating system (DOS)
	– recognize simple disk operating commands
	– install various files and programs
	– create basic programs
	– set up DOS to recognize external devices such as:
	  • printer
	  • modem
	  • joysticks
	– create a config.sys file
	– create an autoexec batch file
	– other similar systems.
	
	Assessment Tool
	ELTLAB–1: Laboratory Practice, Part 2
	
	Standard
	Performance rating of 2 for each applicable task
		30

MODULE ELT2070: COMPUTER TECHNOLOGY (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• set up a computer network	• observed performance in: – connecting a modem to a computer – connecting more than one printer to a network – connecting several computers to form a network. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 3* *Standard* *Performance rating of 2 for each applicable task*	10
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures including: • protective covering on power supplies • working with metal jewelry • using personal grounding systems. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• recognize the purpose of the protective covering on computer power supply and understand voltage and current levels • describe grounding methods when working on computers and use personal grounding systems, such as ankle, wrist straps.	Remove metal jewelry while working on the computer.

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<table>
<tr><th>Concept</th><th>Specific Learner Expectations</th><th>Notes</th></tr>
<tr><td>
Fundamentals</td><td>The student should:
research the history of computer and processors
research the various operating systems of computers
define the following terms:
– central processing unit
– bus
– arithmetic logic unit
– execute/fetch
– instruction set
– instruction cycle
– memory: RAM, EPROM, ROM
– software
– microprocessor
– data (8-bit versus 16-bit versus 32-bit bus)
– macro instruction
– micro instruction
– mnemonics
– operating code
– address
– assembler
describe the environmental, social, economic and political contribution that computers have made to our social fabric
use a disk operating system user's guide.</td><td></td></tr>
</table>

Concept	Specific Learner Expectations	Notes
	The student should:	
System Identification	• identify the following parts of a computer: – power supply – system board (mother board) – random access memory (RAM) – read only memory (ROM) – jumpers – config switches – video adapter – disk controller card – floppy disk – hard drive – signal cable (disk drive) – monitor – keyboard – printer – video control card – power cable • assemble a computer from the above parts • set the system configuration switches • install computer operating system • install monitor/keyboard • test out computer • demonstrate basic computer troubleshooting techniques • use a system board flow chart to locate a system board fault • list symptoms of hard disk drive failure • demonstrate consumer maintenance • explain the use of debug, Fdisk and format • reformat a hard disk drive.	
System Application	• connect a modem to a computer • connect more than one printer to a network • connect several computers to form a network	

Concept	Specific Learner Expectations	Notes
System Application (continued)	*The student should:* • install an operating system • perform simple operating system commands • create a config.sys file • create an autoexec.bat batch file • describe basic commands • create a basic program.	DOS-format commands: • Xcopy • Comp. MAC: • System folder • Start-up item • Extension • Control panels.
Real-world Applications	• define a computer clone • name eight basic hardware modules that make up a computer • identify the system and explain its layout • explain the different sizes and types of expansion boards • identify and compare serial and parallel ports • identify a multi-input/output option adapter cards • explain memory expansion methods • explain the operation of a hard drive • explain how a floppy diskette operates • name the types of cathode-ray tube (CRT) video monitors • define and describe various purposes of software • explain the computer's initialization process • differentiate between start-up procedures.	

MODULE ELT2080: CONTROL SYSTEMS 2

Level: Intermediate

Theme: Computer Logic Systems

Prerequisite: ELT1080 Control Systems 1

Module Description: Students demonstrate how process control technology is used in real-world applications.

Module Parameters: Power supply, oscilloscope, transistor checker, breadboards, frequency counter, digital multimeter and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify discrete components used in process control	*Assessment of student achievement should be based on:* • identifying the following discrete components using computer simulation, computer-assisted instruction (CAI) package or actual components: – rectifiers – silicon controlled rectifier (SCR) – transistors – junction transistor – tricode, alternating current (TRIAC) – diode, alternating current (DIAC) – field effect transistor (FET) – junction field effect transistor (JFET) – metal-oxide semiconductor field effect transistor (MOSFET) – timers (555 ICs) – OP amps (741 ICs) – solid-state relays. *Assessment Tool* *ELT2080–1: Presentations/Reports: Process Controls* *Standard* *Performance rating of 2 for each applicable task*	20

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe analog and sensor components used in process control	• explaining the following analog and sensor components used in process control: – thermistor – pressure sensor – photoelectric transducers – hall effect – opto couplers – bar codes – light controlled resistors – light emitting diode (LED) – photodiode – phototransistor – proximity switches using computer simulation, experimental boards, CAI package or actual devices. *Assessment Tool* *ELT2080–1: Presentations/Reports: Process Controls* *Standard* *Performance rating of 2 for each applicable task*	20
• construct a process control device, using analog and sensor components	• construction of a process control project, using the appropriate components. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 3* *Standard* *Performance rating of 2 for each applicable task*	55
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – correct procedures when working with high voltage including capacitor discharges. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5

MODULE ELT2080: CONTROL SYSTEMS 2 (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • describe hazards associated with voltage (including capacitor discharge), currents, grounded systems, floating systems and isolated systems.	
Fundamentals	• relate schematic diagrams and connection symbols to real-world devices • explain the differences among the following circuit conditions: – grounded system – floating system – isolated system.	
Applied Mathematics	• explain the voltage, current and resistance differences among series, parallel and series parallel circuits, using OHM's Law • explain differences between AC and DC as they related to semi-conductor components.	Practise mathematics skills to calculate resistance, voltage and current values.
Testing	• demonstrate correct use and procedure in operating an oscilloscope • describe an analog signal through both open and closed-loop control systems.	

Concept	Specific Learner Expectations	Notes
System Identification	*The student should:* • explain, experiment with and demonstrate knowledge of various semi-conductor components by prototyping *mini* control circuits in various applications, such as: – rectifiers – SCR – transistors – uni-junction transistor – TRIAC – DIAC – FET – JFET – MOSFET – timers (e.g., 555s) – operational amplifiers – solid-state relays • explain, experiment and demonstrate various semi-conductor transducers and sensors, such as: – thermistor – pressure sensor – photoelectric transducers – hall effect – opto couplers – bar codes – light controller resistors – LED – photodiode – phototransistor – proximity switches.	Temperature control circuits. Light control circuits. Fluid level control circuits, etc. Students may explain, experiment and demonstrate knowledge by breadboarding circuit projects, or using various software programs and trainers. Resource: *Electronics for Industrial Electricians.* Any number of methods may be used by the student to demonstrate knowledge, e.g., breadboarding circuits with various sensors, projects, software programs and trainers.
Real-world Applications	• research applications of solid-state control circuits in automotive, home and industrial application systems.	

MODULE ELT2080: CONTROL SYSTEMS 2 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Fabrication/ Troubleshooting	• construct an electronic project(s) to control home environment or vehicle function: – troubleshoot the project – write a technical report describing the control system operation – develop flow chart and block diagram to show process control in project(s).	E.g., *Electronic Projects to Control Your Home* (Dalton T. Horn). Project could link with ELT2010 Electro-assembly 2 Project could be for car, car alarms, light indicators, fluid level indicators. Home projects could be electronic thermometer, smart thermostat, radiation monitor, automated ventilator, humidifier controller, electronic pest repeller.
	• demonstrate knowledge of testing semi-conductor components such as: – transducers and sensors – use components, transducers and sensors listed above using multimeters, oscilloscopes, solid-state testers.	Signature analysis.
Careers	• research careers primarily in control system environments • list post-secondary institutions that provide control system training.	Collect sample work for portfolio.

MODULE ELT2090:	**ANALOG COMMUNICATION 2**
Level:	Intermediate
Theme:	Communication Systems
Prerequisite:	ELT1090 Analog Communication 1
Module Description:	Students demonstrate the fundamental concepts of electronic analog communication systems.

Module Parameters: Oscilloscope, signal generator, transistor checker, multimeter, dB meter and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify characteristics of analog communication systems	*Assessment of student achievement should be based on:* • using block diagram to explain the operation of a: – telephone – audio amplifier – intercom system – light and sound board – automotive sensor. *Assessment Tool* *ELT2090–1: Presentations/Reports: Analog Communication Systems* *Standard* *Performance rating of 2 for each applicable task*	20
• explain analog communication technology through project design, construction, experimentation, circuit analysis and electronic component identification	• identification of the following electronic components: – diodes – transistors – field effect transistors (FET) – capacitors – resistors using computer simulation, experimental boards, CAI package or actual devices	75

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:* • analysis of the following electronic circuits: – crossover networks – small audio amplifiers – intercoms • using analog test instruments such as multimeters, oscilloscopes, transistor checker, signal generator, IB meters • prototyping mini circuits that demonstrate amplification, filters, crossover networks and transducers • troubleshooting and repairing or maintaining an analog communication system such as a: – portable stereo systems – cassette tape players • observed performance in the design and construction of an audio system project. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 1, 2 and 3* *Standard* *Performance rating of 2 for each applicable task*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – avoidance of dangers of excessive noise levels. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

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MODULE ELT2090: ANALOG COMMUNICATION 2 (continued)

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • identify and describe the difference between dBm and dB ratings of communications systems and the effects on human hearing.	Ear nerve damage resulting from excessive noise levels.
Fundamentals	• research the history of the beginnings of electrical communication • describe what is meant by an analog signal • explain how an electrical signal is turned into sound • identify various devices used to convert sound into electrical signals.	Reference: *Modern Electronic Communication*, p.4.
Applied Mathematics	• mathematically determine component values for crossover/band pass filters.	Speaker design.
System Identification	• draw and explain the block diagram of a simple communication model • identify the differences between wire and wireless telephone systems' technology and networking.	Speakers. Microphones.
Real-world Applications	• using a block diagram, explain the operation of the following forms of analog electronic communication systems: – telephone – audio amplifiers – intercom systems – light and sound boards – automotive sensors (analog).	Fuel/temperature/oil pressure gauges.
Fabricating/Testing	• build a small audio amplifier and/or intercom for personal student use • construct a speaker system with low-, mid- and high-range speakers with appropriate crossover networks such as an intercom system • test project using analog test instruments such as analog multimeter, oscilloscope.	

Concept	Specific Learner Expectations	Notes
Problem Solving	*The student should:* • troubleshoot, repair, maintain analog communication systems used in the home: – portable stereo systems – cassette tape players.	
Careers	• describe how an FM or AM radio station, TV station or theatre uses communication equipment.	

MODULE ELT2100: RADIO COMMUNICATION

Level: Intermediate

Theme: Communication Systems

Prerequisites: ELT1090 Analog Communication 1
ELT2090 Analog Communication 2

Module Description: Students demonstrate the fundamental concepts of electromagnetic communication systems.

Module Parameters: Frequency generator, counter, digital multimeter, hand tools and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • describe the principles of electromagnetic communication systems	*Assessment of student achievement should be based on:* • drawing block diagrams to explain the following communication systems: – AM, FM radio – TV – short-wave radio – satellite communication – cellular telephone – cable television – two-way radio • explaining electromagnetic communication terms such as: – carrier modulation/demodulation – amplitude modulation – frequency modulation – frequency spectrum – stereo – decoder – sidebands – oscillators. *Assessment Tool* *ELT2100–1: Presentations/Reports: Electromagnetic Communication Systems* *Standard* *Performance rating of 2 for each applicable task*	20

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• construct and test electromagnetic communication systems	• constructing and testing the following electromagnetic communication systems: – garage door opener – wireless microphone – AM radio – wireless intercom system • given an oscilloscope, the ability to observe input and/or output frequency associated with the communication system chosen from above. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 2 for each applicable task*	20
• explain wireless communication technology through project construction, experimentation, circuit analysis and electronic component identification of oscillation amplification and detection	• explaining the operation of the following electronic components: – coils – capacitors – field effect transistors (FET) – metal-oxide semiconductor field effect transistors (MOSFET) – operational amplifiers (OP amps) – piezoelectric crystal – varactor • explaining the operation of the following circuits: – resistor capacitor (RC) filters – resistor inductor (RL) – resistor inductor capacitor (RLC) – inductor capacitor (LC) – detector circuits – resonant circuits	55

<table>
<tr><th>Module Learner Expectations</th><th>Assessment Criteria and Conditions</th><th>Suggested Emphasis</th></tr>
<tr><td>The student will:</td><td>Assessment of student achievement should be based on:
• demonstrating an understanding of the following circuits through experimentation and/or computer simulation:
– Hartley oscillator
– Colpitts oscillator
– audio amplifier
– tuned collector oscillator.
Assessment Tool
ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 1, 2 and 3
Standard
Performance rating of 2 for each applicable task</td><td></td></tr>
<tr><td>• demonstrate established laboratory procedures and safe work practices</td><td>• observed performance in following:
– established laboratory procedures
– avoidance of radiation hazards
– avoidance of radio frequency burns.
Assessment Tool
ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices
Standard
Performance rating of 2 for each applicable task</td><td>5</td></tr>
<tr><td>• demonstrate basic competencies.</td><td>• observations of individual effort and interpersonal interaction during the learning process.
Assessment Tool
Basic Competencies Reference Guide and any assessment tools noted above</td><td>Integrated throughout</td></tr>
</table>

<table>
<tr><th>Concept</th><th>Specific Learner Expectations</th><th>Notes</th></tr>
<tr><td>Safety/Resource Management</td><td>The student should:
• demonstrate appropriate safety techniques with respect to:
– radiation hazards
– radio frequency burns.</td><td></td></tr>
</table>

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals	• research the benefits and drawbacks of a wireless communication • research the rules that govern Radio Frequency (RF) communication • explain electromagnetic communication terms leading towards such topics as: – carrier modulation/demodulation – amplitude modulation (AM) – frequency modulation (FM) – frequency spectrum.	Department of Communication, Industry Canada pamphlets.
System Identification	• identify different communication systems that employ electromagnetic communication: – cellular telephones – short-wave radio – AM, FM, TV – satellite communication – high definition TV – cable television (CATV) – facsimile – HAM radio – citizen band – two-way radio • draw and explain a block diagram of a AM/FM communication systems • block diagram various RF communication systems such as cellular phones, cable.	
Fabricating/Testing	• construct a RF communication project • design an antenna to receive a radio signal to include: – determining length of antenna – impedance match • evaluate completed projects.	Project could link with ELT2010 Electro-assembly 2: • AM/FM radio project kit • wireless speaker system • wireless microphone • short-wave antenna • wireless intercom system • garage door opener.

Concept	Specific Learner Expectations	Notes
Real-world Applications	*The student should:* • list the Radio Frequency Spectrum (RFS) and its use in the local area • tour radio/TV station.	Alberta frequency list.
Applied Mathematics/ Testing	• describe signal present at each block of an AM receiver • identify the frequency present in each wave form with an oscilloscope • use an oscilloscope to determine period in seconds and frequency in Hertz (Hz).	Vary the tuning and observe the changes, e.g., carrier frequency, modulating from local oscillating frequency to intermediate frequency.
Careers	• research the conditions required to obtain a HAM radio licence • identify the careers in electronic communication • list the skills of a electronic technologist.	

MODULE ELT2110: SECURITY SYSTEMS 2

Level: Intermediate

Theme: Communication Systems

Prerequisites: ELT1110 Security Systems 1
ELT2080 Control Systems 2

Module Description: Students demonstrate the fundamentals of security technology used in homes, businesses and transportation systems.

Module Parameters: Digital multimeter, soldering station, breadboard, power supply, hand tools and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify and describe elements of a security system	*Assessment of student achievement should be based on:* • identification and description of the components of a security system and how they interface, such as: – control panel – detection device – notification device. *Assessment Tool* *ELT2110–1: Presentations/Reports: Security Systems* *Standard* *Performance rating of 2 for each applicable task*	10

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify detection and notification devices	• identifying the following detection devices: – proximity switch – contact switch – vibration detector – glass breakage detector – photoelectric beam – ultrasonic motion detector – microwave motion detector – infrared motion detector – dual technology detector – various alarms using computer simulation and instruction, actual devices or experimental boards. *Assessment Tool* *ELT2110–1: Presentations/Reports: Security Systems* *Standard* *Performance rating of 2 for each applicable task*	10
• fabricate and operate a detection and notification alarm system for home or car use	• designing/fabricating and operating an electronic security system for personal use. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 2* *Standard* *Performance rating of 2 for each applicable task*	75
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – voltage and current requirements of a security system – correct handling and charging batteries. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • describe voltage and current hazards of security systems • demonstrate correct handling of batteries used in security systems • demonstrate how to recharge a battery safely.	If hardwired in a building, have unit inspected by journeyman.
Fundamentals	• explain terms such as: – transceivers – frequency – microwave – infrared radiation – relays – open and closed contact switches	

Concept	Specific Learner Expectations	Notes
Fundamentals (continued)	*The student should:* • identify and describe the following detection devices: – proximity switches – contact switches – vibration detector – glass breakage detector (foil strip) – photoelectric beam – ultrasonic motion detector – microwave motion detector – passive infrared motion detector – dual technology detectors – audio switch or sound discriminators • explain, experiment or connect various notification devices.	Use audio tapes of breaking glass to test "audio breaking glass detectors" (sound discriminators).
System Identification	• identify the three basic elements of a security system: – control panel – detection devices – means of notification (alarm) • research the differences between two different security systems.	Tour an off-premise monitoring station of a local security company.
Real-world Applications	• install, test and demonstrate an advanced security system incorporating a control panel, detectors, notification devices • explain the operation of various alarms (notification alarms): – identify who is notified by each type of alarm • research long-range security monitoring.	Advanced security systems can be purchased for $150 to $200.

Concept	Specific Learner Expectations	Notes
	The student should:	
Fabricating/Testing	• design or construct an electronic security system for personal use • create a flowchart and block diagram to show detection, monitoring and alarm signals • write a technical report describing the security system.	These SLEs are for the students to build a personal security system for home, car, etc. They will have to research, design, build and install a system, such as: • computalarm • automotive burglar alarm • security alarm • antitheft alarm • tamper-proof alarm • motion-activated motorcycle alarm • blown fuse alarm • sun-powered alarm • freezer meltdown alarm • multiple alarm circuitry • photoelectric alarm system • semiconductor fail-safe alarm • one-chip burglar alarm • high power alarm driver • multi-loop parallel alarm • burglar chaser • heat or light-activated alarm • strobe alert system • exit delay for burglar alarm.
Careers	• identify careers in the security field • create and/or add information to an existing portfolio.	

MODULE ELT2120: ELECTRO-OPTICS

Level: Intermediate

Theme: Communication Systems

Prerequisite: ELT2100 Radio Communication

Module Description: Students demonstrate basic knowledge of lasers and other light wave communication applications in various electronic systems.

Module Parameters: Laser experimental kit and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify common types and classes of lasers	• identification of four classes and six types of lasers *Assessment Tool* *ELT2120–1: Presentations/Reports: Lasers and Fibre Optics* *Standard* *Performance rating of 2 for each applicable task*	10
• explain the operation of laser, fibre optic, infrared and hologram light wave technology	• explanation of the operation of various electro-optic devices related to laser, fibre optics, infrared and hologram light wave technology. *Assessment Tool* *ELT2120–1: Presentations/Reports: Lasers and Fibre Optics* *Standard* *Performance rating of 2 for each applicable task*	15
• construct an electro-optical project	• design and construction of an electro-optical device such as: – lasers – fibre-optics – infrared – holograms. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 3* *Standard* *Performance rating of 2 for each applicable task*	70

<table>
<tr><th>Module Learner Expectations</th><th>Assessment Criteria and Conditions</th><th>Suggested Emphasis</th></tr>
<tr><td>The student will:
• demonstrate established laboratory procedures and safe work practices</td><td>Assessment of student achievement should be based on:
• observed performance in following:
– established laboratory procedures
– correct handling of electro-optic materials
– procedures to prevent eye damage from laser light radiation
– correct handling of high voltage including capacitors.
Assessment Tool
ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices
Standard
Performance rating of 2 for each applicable task</td><td>5</td></tr>
<tr><td>• demonstrate basic competencies.</td><td>• observations of individual effort and interpersonal interaction during the learning process.
Assessment Tool
Basic Competencies Reference Guide and any assessment tools noted above</td><td>Integrated throughout</td></tr>
</table>

<table>
<tr><th>Concept</th><th>Specific Learner Expectations</th><th>Notes</th></tr>
<tr><td>Safety/Resource Management</td><td>The student should:
• follow safe practices when:
– potentially hazardous materials are used in project construction
– in the presence of laser light radiation
– exposed to high voltages around lasers
– using laser classes I, II, III, IV
– working with high voltage capacitors.</td><td></td></tr>
<tr><td>Fundamentals</td><td>• define the word laser
• define fibre optics, infrared, hologram
• describe how light can be used as a modulation medium
• research Canadian Standards Association (CSA) standards/guidelines for lasers
• research laser technology applications</td><td></td></tr>
</table>

Concept	Specific Learner Expectations	Notes
Fundamentals (continued)	*The student should:* • explain terms used in laser technology: – photon – ground state – excited state – spontaneous emission – stimulated emission of radiation – pumping – population inversion – light amplification – lenses – multiwatt lasers • identify and explain operation of the following laser components: – power supply – pumping device – lazing medium – optical resonant cavity • define the following types of lasers: – crystal and glass lasers – gas lasers such as: • helium – neon • helium – cadmium • argon • carbon dioxide • krypton – excimer lasers – chemical lasers – semi-conductor lasers • define lasers in terms of power • draw a block diagram of a laser • explain four unique properties of laser light • explain following terms as related to fibre optics: – reflection – refraction – lenses – focal length – absorption – angle of incidence – bar code – cladding – core – attenuation	

Concept	Specific Learner Expectations	Notes
Fundamentals (continued)	*The student should:* • explain the operation of infrared communication systems • explain the process of producing a hologram • explain the six major types of lenses • explain the effect prisms have upon light • explain beam splitters • describe the effects the following filters have on light: – coloured gel filters – interference filters – dichroic filters • explain diffraction gratings • draw a diagram of a helium-neon laser.	
Designing and Prototyping	• prototype, experiment and analyze the following light wave communication devices: – a visible LED transmitter – an alarm circuit using a phototransistor or opto coupler – a simple infrared remote control device – use a fiber optic cable to route light to a remote location – transmit an analog data through a fibre using a diode laser – construct a simple alarm using high intensity visible light emitting diode	Use traditional laboratories. Use CAI packages. Use fibre and laser experimental kits. The intent of this SLE is for the student to work from easier LED circuits to laser experiments.
	• prototype, analyze and construct an advanced laser, fibre optical, infrared or hologram project; e.g.: – build a He-Ne laser experimenters system – build a pocket laser diode – infrared push-button remote control – infrared wireless speaker system – retrofit old equipment with a remote control – a laser light show – develop a fibre optical communication system – investigate a fibre optic vibration detection system for the home – construct a split-beam transmission hologram.	Depending on the project chosen by the student, additional time may be required – link this module with a Career Transitions module. References: • *The Laser Cookbook, 88 Practical Projects* (Gordon McCombs).

MODULE ELT2130: MAGNETIC CONTROL DEVICES

Level: Intermediate

Theme: Robotic and Control Systems

Prerequisite: ELT1010 Electro-assembly 1

Module Description: Students demonstrate the fundamentals of electromagnetic control devices.

Module Parameters: Multimeter, clamp-on ammeter, power supply, hand tools and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify and state the function of electromagnetic control devices	*Assessment of student achievement should be based on:* • observation of work related to: – identifying the components in an electromagnetic system – identifying the symbols of contactor, magnetic starter, overload protection device, overcurrent protection device, safety disconnect, mechanical relay and solid-state relay components – stating the function of contactor, magnetic starter, overload protection device, overcurrent protection device, safety disconnect, mechanical relay and solid-state relay – drawing the wiring schematic diagram for various electromagnetic systems. *Assessment Tool* *CTSPRE: Assessment Framework: Presentations/Reports* *Standard* *Performance rating of 2 for each applicable task*	20

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MODULE ELT2130: MAGNETIC CONTROL DEVICES (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain the operation of electromagnetically controlled systems	• explaining the operation of various electromagnetically controlled systems as related to: – identify the symbols used in relay logic and wiring schematic diagrams – drawing both relay logic and ladder logic diagrams – explaining the sequence of operation of various electromagnetically controlled systems. *Assessment Tool* *CTSPRE: Assessment Framework: Presentations/Reports* *Standard* *Performance rating of 2 for each applicable task*	20
• design and construct electromagnetic circuits, using ladder logic systems and wiring diagrams	• ongoing performance observation in designing and constructing the electromagnetic circuits as related to: – low voltage and current relay control of a lamp or solenoid – solid-state relay control of a lamp or solenoid – solid-state variable control of a lamp or motor – timing relay control of a lamp or solenoid – manual single-phase toggle motor starter – manual single-phase drum controller motor starter – manual single-phase variable speed control motor starter – two-light source relay operated circuit – single-location panic stop, key start of a power contactor – single-location start/stop of a single-phase magnetic motor starter – two-location start/stop of a single-phase magnetic motor starter – single-location forward reverse stop of a single-phase magnetic motor starter – single-location start/stop jog of a single-phase magnetic motor starter – single-location solid-state relay and low voltage control circuit of a single-phase magnetic motor starter. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 2 for each applicable task*	55

MODULE ELT2130: MAGNETIC CONTROL DEVICES (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – prevention procedures for current leakage in solid-state relays – correct use of protective devices for circuits. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 2 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate safety in all practices including solid-state relay current leakage • follow safe wiring practices • use protective devices for all circuits.	Breakers, fuses, O/L coils and safety disconnects. Observe lockout and tagout procedures.
Fundamentals	• research the benefits and drawbacks of electro-magnetic and solid-state relays • identify coil voltage and frequency rating • identify contact voltage and current ratings • compare and contrast the use of relays, solenoids, actuators in electrical circuits	Better circuit isolation. Nameplate ratings.

MODULE ELT2130: MAGNETIC CONTROL DEVICES (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals (continued)	• demonstrate knowledge of electromagnetism	Magnetic fields around: • single conductor • coil • magnetic polarity • left-/right-hand rule.
	• demonstrate knowledge of activation principles.	Solenoid principles. Relay principle.
Designing and Prototyping	• draw a schematic and wiring diagram and construct the following electromagnetic circuits: – toggle switch controls load – stop/start button controls loads – stop/start from two locations – jogging – reversing – annuciator and indicators – limit switches.	Electric valve control. Circuit initiation control.
	• create a flow chart of various magnetic control systems.	Elevator, ski lift, light control, fail-safe latching control, AC/DC isolation relay, assembly line.
Careers	• research application in industry of magnetic control devices and employment opportunities.	

MODULE ELT2140: ROBOTICS 2

Level: Intermediate

Theme: Robotic and Control Systems

Prerequisite: ELT1130 Robotics 1

Module Description: Students demonstrate the fundamental concepts of sensor devices and control systems, by building an electronic circuit to control a direct wire or mobile robot.

Module Parameters: Multimeter, power supply, soldering stations, hand tools and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• design and build a sensor device and control system for the robotic system	• designing and building a sensory control circuit to operate and control a robotic system. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 2 for each applicable task*	65
• identify sensor control systems and subsystems used in robotic systems	• identifying sensor control system and subsystem used in the robotic system, such as: – photoelectric – sound – tactile – proximity – thermal. *Assessment Tool* *ELT2140–1: Presentations/Reports: Robotic Sensor Controls* *Standard* *Performance rating of 2 for each applicable task*	10
• explain sensory control circuits and components used in the robotic control system	• explanation of the sensory control circuits and components used to control a drive circuit. *Assessment Tool* *ELT2140–1: Presentations/Reports: Robotic Sensors* *Standard* *Performance rating of 2 for each applicable task*	10

MODULE ELT2140: ROBOTICS 2 (continued)

<table>
<tr><th>Module Learner Expectations</th><th>Assessment Criteria and Conditions</th><th>Suggested Emphasis</th></tr>
<tr><td>The student will:
• operate and demonstrate the capabilities of a robotic system equipped with sensor controls</td><td>Assessment of student achievement should be based on:
• operating the various sensor control system and subsystem used in the robotic system.
Assessment Tool
ELTLAB–1: Laboratory Practice, Part 4
Standard
Performance rating of 2 for each applicable task</td><td>10</td></tr>
<tr><td>• demonstrate established laboratory procedures and safe work practices</td><td>• observed performance in following:
– established laboratory procedures
– safe wiring practices related to sensory control system
– use and disposal of chemicals related to circuit board construction
– use of solder and fluxes.
Assessment Tool
ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices
Standard
Performance rating of 2 for each applicable task</td><td>5</td></tr>
<tr><td>• demonstrate basic competencies.</td><td>• observations of individual effort and interpersonal exploration during the learning process.
Assessment Tool
Basic Competencies Reference Guide and any assessment tools noted above</td><td>Integrated throughout</td></tr>
</table>

<table>
<tr><th>Concept</th><th>Specific Learner Expectations</th><th>Notes</th></tr>
<tr><td>Safety/Resource Management</td><td>The student should:
• demonstrate safe wiring practices when building a sensory control system
• use protection devices for all circuits including fusing and temperature cutoff
• operate robotic systems within design tolerances.</td><td></td></tr>
</table>

MODULE ELT2140: ROBOTICS 2 (continued)

<table>
<tr><th>Concept</th><th>Specific Learner Expectations</th><th>Notes</th></tr>
<tr><td>Fundamentals</td><td>The student should:
demonstrate the principles of a photoelectric, sound, tactile, proximity and thermal sensor
explain the operation of the electronic components and circuits used to build sensor controls
explain how sensor control systems are used to control the drive circuit.</td><td>Project constructed and/or available robotic units.</td></tr>
<tr><td>System Identification</td><td>draw and explain the various blocks in a sensor control system
describe and explain sight, sound and tactile sensor devices
explain the fundamentals of the control system operating the motor drives in the robotic system
identify the differences among drive systems, sensor control systems and processing systems.</td><td>Project built in Electro-assembly and use with other robotic units.</td></tr>
<tr><td>System Application</td><td>research the benefits and drawbacks of various sensory devices that are used to control the robot
describe where industry is making use of sensory control robots.</td><td>Tour an industrial plant using robots.</td></tr>
<tr><td>Designing and Prototyping</td><td>demonstrate a knowledge of sensory control systems by building a sensor control for the robot system selecting from the following:
– photoelectric
– sound
– tactile
– proximity
– thermal
prototype a sensory control system and construct the circuit so that the sensor controls the motors on the robot
draw the schematic diagram of the sensor control circuit.</td><td>Robotic kit.</td></tr>
</table>

Concept	Specific Learner Expectations	Notes
Fabricating/Testing	*The student should:* • assemble electronic components to build a sensor • build a sensory control and mount the sensory control on the control robot.	

MODULE ELT2150:	**ELECTRONIC CONTROLS**
Level:	Intermediate
Theme:	Robotic and Control Systems
Prerequisite:	ELT2130 Magnetic Control Devices
Module Description:	Students demonstrate the fundamentals of ladder/relay logic programming, and demonstrate how the program's logic controller system operates.

Module Parameters: Programmable logic controller, soldering station, hand tools and related resources.

Note: The student must have access to instruction from an individual with journeyman qualifications when projects are hardwired to main power supply and for permanent usage.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain basic input and output hardware and fundamentals of basic programming in programmable logic controller systems	• explaining the basic input and output hardware components used with the fundamentals of basic programming as found in programmable logic controller (PLC)systems. *Assessment Tool* *ELT2150–1: Presentations/Reports: Programmable Controls* *Standard* *Performance rating of 2 for each applicable task*	10
• write a basic programming logic code, through real or programmed inputs on a programmable logic system, to operate and control electromagnetic devices	• writing the basic programming logic code using real or programmed inputs to operate electromagnetic devices in a programmable logic system	85

<table>
<tr><th>Module Learner Expectations</th><th>Assessment Criteria and Conditions</th><th>Suggested Emphasis</th></tr>
<tr><td>The student will:
• wire, operate and test a programmable electromagnetic device</td><td>Assessment of student achievement should be based on:
• wiring the input control and output electromagnetic devices that are operated by various programming instruction codes set up in a PLC such as:
– timing relay control of a lamp or a solenoid
– two-light source relay operated circuit
– single-location panic stop, key start of a power contactor
– single-location start/stop of a single-phase motor
– two-location start/stop of a single-phase motor
– single-location forward/reverse/stop of a single-phase motor
– single-location start/stop/jog of a single-phase motor.
Assessment Tool
ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 2, 3 and 4
Standard
Performance rating of 2 for each applicable task</td><td></td></tr>
<tr><td>• demonstrate established laboratory procedures and safe work practices</td><td>• observed performance in following:
– established laboratory procedures
– procedures for correct use of electrical protective devices.
Assessment Tool
ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices
Standard
Performance rating of 2 for each applicable task</td><td>5</td></tr>
<tr><td>• demonstrate basic competencies.</td><td>• observations of individual effort and interpersonal interaction during the learning process.
Assessment Tool
Basic Competencies Reference Guide and any assessment tools noted above</td><td>Integrated throughout</td></tr>
</table>

MODULE ELT2150: ELECTRONIC CONTROLS (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate safe wiring practices when wiring the inputs and output circuits • use protection devices for all circuits.	Low voltage wiring, grounding, separation of voltages, fusing. Live voltage projects must be activated through GFI circuit breaker. When instructional journeyman qualifications restrict high voltage use, projects may be done in low voltages (less than 30 volts).
System Identification	• draw and identify the various blocks of a PLC system • describe and explain numbering systems and codes • plan PLC ladder programs and wiring diagrams of the PLC system • demonstrate the fundamentals of logic • compare relay logic control and PLC programming • identify the differences between a wired relay motor control panel and a PLC motor control panel.	Housing, addresses, wiring diagram, relay logic, ladder logic. Application of Boolean logic.
System Application	• research the benefits and drawbacks of using the PLC • research where, how and why PLCs are used in industry.	Tour mill, gas plant or other industrial plants.
Fundamentals	• demonstrate principles of electromagnetic relay output devices to control motors • demonstrate the action of switch devices as an input sensor device • explain how an AC motor is operated from a PLC.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Designing and Prototyping	• demonstrate a knowledge of PLC function by writing basic programs to operate a simple relay logic control of AC motors • design the relay logic program and construct the input and output devices so that the PLC can control electromagnetic and indicator lamps • convert relay ladder diagrams into PLC ladder programs • draw PLC ladder programs complete with wiring diagram of inputs and outputs systems.	Inputs: limit switches, sensors, push buttons. Outputs: lamps, motors relays.
Fabricating/Testing	• build and program a multi input/output PLC control installation.	
Careers	• describe where industry is making use of PLC and employment opportunities.	Tour an industrial plant.

MODULE CURRICULUM AND ASSESSMENT STANDARDS:

SECTION F: ADVANCED LEVEL

The following pages define the curriculum and assessment standards for the advanced level of Electro-Technologies.

> Advanced level modules demand a higher level of expertise and help prepare students for entry into the workplace or a related post-secondary program.

Module ELT3010: Electro-assembly 3 .... F.3
Module ELT3020: Electronic Servicing F.7
Module ELT3030: Power Systems & Services F.11
Module ELT3040: Generation/Transformation F.15
Module ELT3060: Digital Technology 3 .... F.21
Module ELT3070: Digital Applications F.25
Module ELT3080: Microprocessors F.29
Module ELT3090: Microprocessor Interface F.35
Module ELT3100: Analog Communication 3 .... F.41
Module ELT3110: Amplifiers F.49
Module ELT3130: Data/Telemetry Systems F.55
Module ELT3140: Motors F.61
Module ELT3150: Robotics 3 .... F.65
Module ELT3160: Control Applications F.69

MODULE ELT3010:	**ELECTRO-ASSEMBLY 3**
Level:	Advanced
Theme:	Fabrication and Service Principles
Prerequisite:	ELT2010 Electro-assembly 2
Module Description:	Students apply photographic processes to construct a printed circuit for an electronic project.

Module Parameters: Photographic printed circuit board supplies, image product equipment and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify three photographic printed circuit (PC) board construction methods	• identifying and describing three methods to prepare an electronic circuit board for etching. *Assessment Tool* *ELT3010–1: Presentations/Reports: Printed Circuit Boards* *Standard* *Performance rating of 3 for each applicable task*	10
• design or modify a board layout to be used for photographic PC board construction	• identifying, designing and drawing a circuit board foil layout and constructing an electronic circuit board. *Assessment Tool* *ELTPAF: Project Assessment Form* *Standard* *Performance rating of 3 for each applicable task*	30
• construct a PC board, using a photographic method	• identifying and constructing the circuit board foil layout by one of three photographic methods. *Assessment Tool* *ELTPAF: Project Assessment Form* *Standard* *Performance rating of 3 for each applicable task*	35

MODULE ELT3010: ELECTRO-ASSEMBLY 3 (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• assemble a project, using a PC board	• identifying, components values and polarity to construct a circuit board project. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 3 and 4* *Standard* *Performance rating of 3 for each applicable task*	20
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – chemical, solder, flux precautions for PC board construction. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• describe illness caused by chemical, solder and flux materials used in prototype construction • demonstrate appropriate safety techniques when using solder and chemicals for prototype construction • identify and follow safety procedures in home/laboratory while using solder, flux, photochemicals, cleaning chemicals and etching chemicals • use WHMIS data sheets.	Discuss the safe use of hazardous materials used in the production and assembly of PC boards.

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals	• research the benefits and drawbacks of various photographic construction methods	List and explain the differences between various photographic prototype assembly methods; i.e., positive, negative, silk screening, toner transfer, computer.
	• use schematic symbols to represent electronic components • match actual components to schematic symbols.	
System Application	• draw and/or modify schematic diagrams for an advanced electronic circuit.	*Electronic Workbench*, circuits, magazines, etc.
Designing and Prototyping	• create the photographic artwork circuit layout for a PC board.	
Fabricating/Testing	• use the circuit layout with one of the photographic methods to make a circuit board	
	• demonstrate how to troubleshoot the fabricated electronic circuit board	Continuity check of copper strip.
	• use multimeter for voltage, current and resistance checks.	
Careers	• research employment opportunities in photographic and surface mount design, technology and construction.	

MODULE ELT3020:	**ELECTRONIC SERVICING**
Level:	Advanced
Theme:	Fabrication and Service Principles
Prerequisite:	ELT2020 Electrical Servicing
Module Description:	Students develop and apply basic processes and skills to service and repair consumer-based electronic products.

Module Parameters: DMM, Isolation transformer, oscilloscope, soldering iron, chemical cleaners, chamois cleaning sticks, foam swabs, transistor tester, capacitance meter and related resources. Optional Equipment: colour pattern generator, CRT tester/restorer, high voltage test probe, alignment tools.

Supporting Modules: ELT2090 Analog Communication 2
ELT2100 Radio Communication

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• use a block diagram to show the function and the stages of operation of an electronic device	• developing a block diagram and describing how each section in the block diagram operates for a given consumer electronic product. *Assessment Tool* *ELT3020–1: Presentations/Reports: Electronic Service and Repair* *Standard* *Performance rating of 3 for each applicable task*	30
• identify system faults, and propose solutions to service and repair various digital and analog consumer products	• identifying problems, and proposing solutions to service various consumer electronic products. *Assessment Tool* *ELTCSR: Customer Service, Part 1* *Standard* *Performance rating of 3 for each applicable task*	35
• use standard, safe practices to service/ repair an electronic component or device	• observation in using the solution to repair/service consumer electronic products. *Assessment Tool* *ELTCSR: Customer Service, Part 2* *Standard* *Performance rating of 3 for each applicable task*	35

MODULE ELT3020: ELECTRONIC SERVICING (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• create a profile of a trade or occupation within the field of electronic servicing	• completing a career profile within the field of electronic equipment servicing. *Assessment Tool* *ELTCPC: Assessment Guide: Career Profiles* *Standard* *Completing all sections of career profile chart*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate a safe attitude • use proper grounding techniques when testing consumer electronic devices • use proper handling techniques when working on cathode-ray tubes and high voltages.	Personal protection. Always ground out high voltage capacitors. Implosion hazard.
System Identification	• identify stages of operation of various consumer systems • interpret a flow diagram and schematics of various consumer systems.	TV, VCR, camcorder, receiver, computer, microwave oven and other consumer devices.
Problem Solving	• identify problems associated with various consumer products and propose a solution to affect the repair.	VCR head cleaning and alignment. TV alignment and colour adjustment.

Concept	Specific Learner Expectations	Notes
Applied Mathematics	*The student should:* • use an oscilloscope to determine period in seconds and frequency in Hertz (Hz) • identify measurements in engineering notation.	
Testing	• identify and test components in faulty section(s).	Transistor, diodes, capacitors, VCR drive systems, PC boards.
Repair/Service/ Maintenance	• demonstrate how to: – service faulty section – clean user controls – adjust colour balance, vertical height/linearity of a TV or monitor – clean a VCR head and tape running system – adjust VCR tape tracking system – clean belts and lubricate a VCR – repair or replace PC boards.	Tuner, volume control, etc. Games systems or other consumer devices. Upgrading personal computers.
Careers	• research employment opportunities in electronic service and repair.	Consumer electronic.

MODULE ELT3030: POWER SYSTEMS & SERVICES

Level: Advanced

Theme: Power Systems

Prerequisite: ELT2030 Branch Circuit Wiring

Module Description: Students construct, operate, analyze and evaluate various single-phase and three-phase power systems and services.

Module Parameters: Three-phase power supply, three-phase panel, transformers, wattmeter, multimeter, AC current meter, knife switches, fused safety disconnect switch, volt-amp clamp or probe and related resources.

Note: The student must have access to instruction from an individual with Electrical Technologist or journeyman status when students are performing practical components other than low voltages

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• follow established, safe laboratory procedures and practices when working with three-phase systems	• observed performance in following: – established laboratory procedures – using proper levels of circuit protection. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• construct and analyze a three-wire, single-phase electrical system	• constructing, analyzing and evaluating a three-wire Edison system. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 3* *Standard* *Performance rating of 3 for each applicable task*	25

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• analyze common reluctance inductance (RLC) vector diagrams	• explaining the operating principles of the following voltage and current vector diagrams: – resistive circuit – inductive reactive circuit – capacitive reactive circuit – inductive and capacitive circuit – resistor inductor capacitor circuit – line voltage in a wye and delta system. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Parts 1 and 2* *Standard* *Performance rating of 3 for each applicable task*	15
• construct and analyze three-wire, three-phase and four-wire, three-phase wye systems	• constructing, analyzing and evaluating various three-wire and four-wire three-phase systems such as: – three-phase, three-wire wye system – three-phase, four-wire wye system. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 3 for each applicable task*	25
• construct and analyze three-wire, three-phase delta systems	• constructing, analyzing and evaluating various three-wire and four-wire three-phase systems such as: – three-phase, three-wire delta system – three-phase, four-wire delta system. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 3 for each applicable task*	25
• create a profile of a trade or occupation within the field of power systems and services	• completing a career profile of a trade or occupation within the field of electrical power systems and services. *Assessment Tool* *ELTCPC: Assessment Guide: Career Profiles* *Standard* *Completing all sections of profile chart*	5

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate safe practices in all activities, observing lockout and tagout procedures.	Individual fuses (e.g., five amps for each laboratory set-up). Live voltage projects must be activated through GFI circuit breaker. When instructional journeyman qualifications restrict high voltage use, projects may be done in low voltages (less than 30 volts).
System Identification	• analyze single-phase three-wire systems for voltages and currents • identify and diagram wye and delta systems.	Use a scientific calculator.

MODULE ELT3030: POWER SYSTEMS & SERVICES (continued)

Concept	Specific Learner Expectations	Notes
Applied Mathematics	*The student should:* • mathematically analyze three-phase three-wire delta and three-phase three-wire wye systems for line and phase voltage and currents • mathematically analyze three-phase four-wire wye systems for neutral currents • energize various three-phase wye and delta circuits; measure line, phase voltages and currents • solve phasor diagrams using trigonometry • develop and use three-phase power formula • energize various three-phase wye and delta circuits; calculate and measure three-phase power consumed.	Use a scientific calculator.
Testing	• diagram two-meter and three-meter wattmeter connections to measure three-phase power • diagram current transformer connections.	Keep currents as low as possible
Real-world Applications	• diagram and construct a mock-up of a house service, according to Canadian Electrical Code (CEC) • diagram and construct a mock-up of a three-phase service, according to CEC • evaluate three-phase three- and four-wire data systems.	
Careers	• explore areas where certification as an electrician is required.	Electrician, power electrician, lineman, elevator electrician, communication electrician.

MODULE ELT3040: GENERATION/TRANSFORMATION

Level: Advanced

Theme: Power Systems

Prerequisite: ELT1030 Conversion & Distribution

Module Description: Students operate, experiment with and analyze alternators and transformers used in power generation and distribution.

Module Parameters: AC/DC motor generator set, transformer kit, AC/DC volt ampmeters, multimeter and related resources.

Note: The student must have access to instruction from an individual with Electrical Technologist or journeyman status when students are operating low voltage alternators.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • explain the principles of operation of electrical components used in safety devices	*Assessment of student achievement should be based on:* • identifying and explaining the principles of operation of the following electrical safety protection devices: – plug and cartridge fuse – renewable and time-delay fuse – bi-metal and time-delay circuit breaker – overload protection by means of fuses and magnetic or thermal overload relays – ground-fault interrupter circuit protectors – safety switches. *Assessment Tool* *ELT3040–1: Presentations/Reports: Power Generation and Transformation* *Standard* *Performance rating of 3 for each applicable task*	10

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Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• set up and operate three-phase low voltage alternators in no load and load conditions	• setting up and operating a three-phase alternator under load and no load conditions • demonstrating resistive, inductive and capacitive load conditions • collecting data to plot the load graph. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 2* *Standard* *Performance rating of 3 for each applicable task*	25
• explain the operational and loading parameters for alternators	• explaining the following alternator parameters: – voltage generation – alternator regulation – voltage regulators – paralleling alternators – hunting – losses and efficiency – ratings – power factor – load characteristics graphs. *Assessment Tool* *ELT3040–1: Presentations/Reports: Power Generation and Transformation* *Standard* *Performance rating of 3 for each applicable task*	10
• operate a low voltage alternator in parallel with another alternator(s)	• setting up and operating a three-phase low voltage alternator in parallel with another power source. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 2* *Standard* *Performance rating of 3 for each applicable task*	15

MODULE ELT3040: GENERATION/TRANSFORMATION (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the operating principles of single-phase transformers	• setting up and operating a single-phase transformer in these conditions: – transformation characteristics – transformer polarity – transformer regulation – autotransformer characteristics – distribution transformers – transformers in parallel. *Assessment Tool* *ELT3040–1: Presentations/Reports: Power Generation and Transformation* *Standard* *Performance rating of 3 for each applicable task*	25
• identify fundamental loading characteristics of single-phase transformers	• explaining the following single-phase transformer fundamentals: – theory of operation; no load – theory of operation; under load – transformer ratings – transformer ratios – losses and efficiency – autotransformer. *Assessment Tool* *ELT3040–1: Presentations/Reports: Power Generation and Transformation* *Standard* *Performance rating of 3 for each applicable task*	10
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – correct procedures for high voltage applications – correct use of isolation transformers – correct use of overcurrent and overload protection. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate safe practices especially regarding high voltage system application, use of isolation transformers • differentiate between overload and overcurrent protection • use various electrical tests to insure safety of equipment/projects • describe dangers relating to rotating shafts.	Observe hazards associated with backfeed on transformers. • Sloblow fuse • HRC fuse • circuit breaker • other overload devices. Live voltage projects must be activated through GFI circuit breaker. When instructional qualifications restrict high voltage use, projects may be done in low voltages (less than 30 volts).
Testing	• demonstrate a knowledge of alternator function by operating a three-phase alternator for various voltages, frequencies and phase sequences.	Small motor-generator sets are available on 1/3 horsepower machines. Surplus automotive alternator could be used.
Designing and Prototyping	• build a working model of a three-phase alternator.	Stationary coil moving magnet or vice versa.

Concept	Specific Learner Expectations	Notes
	The student should:	
Real-world Applications	• set up and operate or report on the operation of alternators in parallel • compare alternators and generators • inspect transformer installations used to produce correct voltage for consumer's equipment.	Alternators are brought "on-line" as necessary to supply loads in commercial power grids. Students could operate two or more alternators to supply a load in the laboratory. Electronic power supplies, school power service, field trip to substation, etc.
Designing and Prototyping	• construct, operate and analyze step-up, step-down, 1:1, isolation and variable transformers such as: – Jacob's ladder – Tesla coil – mutual induction coil.	*Radio Electronics Magazine.*
Applied Mathematics/ Fundamentals	• explain principles of transformer action such as: – apparent power – voltage ratio – turns ratio – power transfer – voltage, amperage rating • explain schematic symbols and nameplate ratings.	A report could be prepared on the specific transformer built.
Careers	• research employment opportunities in power generation and transformation.	

MODULE ELT3060: DIGITAL TECHNOLOGY 3

Level: Advanced

Theme: Computer Logic Systems

Prerequisite: ELT2060 Digital Technology 2

Module Description: Students demonstrate knowledge of digital principles by using medium-scale transistor–transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) integrated technology.

Module Parameters: Digital logic trainer, logic probe, oscilloscope, function generator and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify, interface and experiment with medium-scale integrated circuit (IC) families	*Assessment of student achievement should be based on:* • identifying medium-scale integrated circuits using data manuals, disks and CD-ROM programs on a given a manufactured chip • explaining the difference between typical and complex networks such as: – decoders – encoders – multiplexers – parity generators – subtractors – shift registers • prototyping, measuring and evaluating medium-scale integrated (MSI) circuits such as: – keyboard encoder – binary coded decimal (BCD) decoder – comparators – arithmetic circuits. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 1, 2 and 3* *Standard* *Performance rating of 3 for each applicable task*	40

MODULE ELT3060: DIGITAL TECHNOLOGY 3 (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify components, construct a prototype and experiment with typical medium-scale logic networks	*Assessment of student achievement should be based on:* • explaining the difference between memories such as: – RAM – ROM – PROM – EPROM • prototyping and experimenting with typical medium-scale logic networks such as: – BCD-to-Seven Segment Decoders/drivers – self stopping counters – Universal Shift Registers – four-bit adder/subtractors – binary multipliers – 2s complement adder/subtractors – frequency dividers • constructing MSI digital circuits incorporated within the following digital systems – calculator – digital clock – frequency counter – error detectors. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 1, 2 and 3* *Standard* *Performance rating of 3 for each applicable task*	50
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – safe procedures for handling of medium-scale integrated circuit (MSIC) chips – observing antistatic procedures. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• create a profile of a trade or occupation within the field of digital technology	• completing career profile chart within the field of digital technology. *Assessment Tool* *ELTCPC: Assessment Guide: Career Profiles* *Standard* *Completing all sections of profile chart*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate correct handling of MSIC chips • describe antistatic procedures.	Demonstrate use of wristwraps. MSIC=medium-scale integrated circuits, wristwraps.
Fundamentals	• explain the difference between typical and complex logic networks.	Decoder, encoder, code converter, multiplexers, parity generators, subtractors.
Designing and Prototyping	• fabricate digital circuitry using medium-scale integration • construct, experiment and solve real-world applications, using medium-scale integration.	Tachometer, DHTA decoder, Music Box. Electronic keyboard to seven-segment display. Could be linked to ELT2010 or ELT3010 for printed circuit board.
Testing	• measure and evaluate medium-scale integrated circuits.	Keyboard endcoder, BCD decimal decoder, four-bit magnitude comparators.

Concept	Specific Learner Expectations	Notes
Careers	*The student should:* • research employment opportunities in medium-scale TTL and CMOS integrated technology.	

MODULE ELT3070: DIGITAL APPLICATIONS

Level: Advanced

Theme: Computer Logic Systems

Prerequisite: ELT3060 Digital Technology 3

Module Description: Students experiment with large-scale and very large-scale integrated circuits, and demonstrate their applications to practical situations.

Module Parameters: Logic probes, logic analyzer, signature analysis, oscilloscopes and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify applications and develop prototypes of large-scale integrated circuits	*Assessment of student achievement should be based on:* • demonstrating correct handling and use of large-scale integrated circuits (LSICs). Prototyping and troubleshooting digital system such as: – microcomputer – liquid crystal display (LCD) timer with alarm – electronic game – digital voltmeter – digital light meter • constructing circuits using LSICs incorporated within any video, stereo, audio or computer systems or advanced project of student choice • experimenting with a practical large digital integration (LDI) system such as: – clock – data transmission – video games. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 1 and 2* *Standard* *Performance rating of 3 for each applicable task*	50

MODULE ELT3070: DIGITAL APPLICATIONS (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• troubleshoot a digital system or prototype with digital equipment	• incorporating a LSIC digital system on a given previous student project or a consumer product, using one of the following instruments to analyze and troubleshoot a circuit: – logic probes – pulser – logic analyzer – signature analyzer – oscilloscopes using computer simulation, experimental boards, CAI package or actual equipment. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Part 3* *Standard* *Performance rating of 3 for each applicable task*	45
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – correct handling and storage of LSIC and VLSIC chips. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• demonstrate correct handling and storage of large integrated circuit (LSIC) and very large integrated circuit (VLSIC) chips.	

MODULE ELT3070: DIGITAL APPLICATIONS (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Real-world Applications	• prototype and troubleshoot a digital system such as a calculator, computer, adder/subtractor, digital clock, frequency counter, alarms, games	Any electronic problem with multiple inputs and outputs will do. Truth tables will need to be constructed. Texts: *Digital Electronics* (Chapter 12), *Principles of Digital Audio.*
	• identify the application of pinouts and use of complex IC chips from several manufacturers.	Use memory interfacing, drivers, support and advanced support IC.
Fundamentals	• research and investigate a complex digital system • identify the function of ICs in a large complex digital circuit	Examples of texts that may be helpful: *18 Advanced Electronic Projects, Video, Stereo and Opto Electronics. Digital Computer Circuits and Concepts.*
	• explain, experiment with and demonstrate the differences among digital memories • research memory configuration and organization • construct various memory circuits	For example, RAM, ROM, PROM, EPROM, magnetic core memory, computer bulk storage devices.
	• explain and demonstrate the differences among various digital displays and drivers	LCD, seven segments, etc.
	• explain and demonstrate the differences among various digital interfacing devices	Line drivers and receivers, digital to analog converters, analog to digital converters, serial and parallel transfer, UART, RS-232C operational amplifiers.
	• explain and demonstrate the differences among various support and advanced support ICs.	UART, Parallel I/O, 8253 Counter Timer, 8225 Programmable CRT controller, 1535-488 controlled cursor generator.

Concept	Specific Learner Expectations	Notes
	The student should:	
Fabricating/Testing	• construct circuits using LSICs	Could be linked with Electro-assembly 2 or Electro-assembly 3, robotics unit for printed circuit board.
	• use one of the following instruments to analyze a complex digital circuit: – logic probes – pulser – logic analyzer – signature analyzer – oscilloscopes.	In place of some of these actual instruments, student may have to use software such as *Electronic Workbench.*

MODULE ELT3080: MICROPROCESSORS

Level: Advanced

Theme: Computer Logic Systems

Prerequisite: ELT3070 Digital Applications

Module Description: Students compare the internal architecture of microprocessors and program them, using instruction sets.

Module Parameters: Microprocessor trainer/CAI program and related resources.

Supporting Modules: ELT2070 Computer Technology
INF3010 Hardware/Software Analysis [Information Processing Strand]

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • compare the internal architecture of various families of microprocessors	*Assessment of student achievement should be based on:* • explaining the difference in internal architecture between different families of microprocessors • identifying and comparing the following functional sections in a microprocessor: – accumulator – program counter – instruction decoder – controller – data register – address register – stack pointer – index pointer • drawing a block diagram of an advanced microprocessor showing its internal architecture. *Assessment Tool* *ELT3080–1: Presentations/Reports: Microprocessors* *Standard* *Performance rating of 3 for each applicable task*	20

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• program a microprocessor, using instruction sets	• writing and executing programs using mnemonic and op codes that complete the following functions: – branching – additions/subtractions – indexed and extended addressing – store data and retrieve data from the stack – loops – moving data between several places. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 1 and 4* *Standard* *Performance rating of 3 for each applicable task*	55
• describe input/output operations in microprocessors	• writing and executing various programs that use memory input and output devices. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	20
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – procedures to avoid hazard of static electricity – procedures indicating awareness of high voltage requirements. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • be aware of potential damage to integrated circuits by static electricity • be aware of current and voltage requirements of computer trainers • demonstrate proper safety procedures while testing microprocessor pins.	
Fundamentals	• compare the difference in internal architecture between different families of microprocessors • explain the differences between machine and assembly language, interpretative and compiler language • define the following terms: – microprocessor – input/output – instruction set – operand – mnemonic – opcode – data/address • describe and locate the types of microprocessor used in a computer or trainer • identify input/output pins of a microprocessor • identify EPROMS, RAM ICs • identify memory read/write address and data pins on a memory chip • write and execute various programs that use memory, input and output devices • draw the symbols used in flow charting and explain the purpose of each • define and explain how the following are used in programming: – inherent, immediate and direct addressing – conditional and unconditional branching – stack operation/pointer, cascade, pop push/pull instructions – subroutines – carry, negative, zero, overflow, flag operation.	Use Debug in DOS.

Concept	Specific Learner Expectations	Notes
System Identification	*The student should:* • explain the purpose of the following functional sections in a microprocessor: – accumulator – program counter – instruction decoder – controller – data register – address register – stack pointer – index pointer • explain the evolution of architecture from 8 bit on • draw a block diagram of an advanced microprocessor showing its internal architecture • identify differences between data address, instruction, flag registers • define a machine cycle • relate clock frequency to microprocessor speed.	The accumulation for math commands in older microprocessors can be used, newer ones can store math and logic commands in any register. Note: Address, data size, number of instructions, size of control set. Done at machine or assembler level programming.
Real-world Applications	• write and execute a simple straight program using mnemonic and op codes • demonstrate the uses and characteristics of different addressing modes by writing and analyzing assembly language programs • compute the proper relative address for branching forward or backward from one point to another in a program • write and execute a program that can, e.g.: – multiply by repeated additions – divide by repeated subtractions – convert binary to BCD • write and execute simple programs that use indexed and extended addressing • given an instruction, locate the op code, calculate the number of machine cycles, find the number of bytes and give the final output	A microprocessor trainer is required. It may be necessary to purchase a microprocessor programming course to cover these SLEs from one of the above or others. Also, using Debug in DOS from generic computers can be used.

MODULE ELT3080: MICROPROCESSORS (continued)

Concept	Specific Learner Expectations	Notes
Real-world Applications (continued)	*The student should:* • write and execute a simple program that can store data in and retrieve data from the stack • write and execute a program that uses the stack and indenting registers to move data between two places.	
Careers	• research the curriculum of post-secondary institutions that teach microprocessor fundamentals • research computer engineering, computer technologists and computer technicians occupations.	

MODULE ELT3090: MICROPROCESSOR INTERFACE

Level: Advanced

Theme: Computer Logic Systems

Prerequisites: ELT2080 Control Systems 2
ELT3080 Microprocessors

Module Description: Students demonstrate how to interface microprocessors/microcontrollers with real-world applications.

Module Parameters: Microprocessor trainer, interfacing trainer, with accompanying CAI package and related resources.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • describe microprocessor interface output and input circuits	*Assessment of student achievement should be based on:* • explaining the following – input/output circuits as they apply to microprocessors – the two main methods of I/O operation in microprocessors – a simplified microprocessor interface – the term "interrupt" – the difference between various interface devices – how to interface a D/A converter to a microprocessor system. *Assessment Tool* *ELT3090–1: Presentations/Reports: Microprocessor Interface* *Standard* *Performance rating of 3 for each applicable task*	10

MODULE ELT3090: MICROPROCESSOR INTERFACE (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain the operation of a serial interface device	• explaining the following: – an interface device and its relationship to data, control circuits and data direction registers – how serial data can be represented using both amplitude and frequency modulation techniques – the difference between asynchronous and synchronous serial data transmission – convert serial data to parallel and vice versa. *Assessment Tool* *ELT3090–1: Presentations/Reports: Microprocessor Interface* *Standard* *Performance rating of 3 for each applicable task*	10
• interface a digital-to-analog (D/A) and analog-to-digital (A/D) converter to a microprocessor	• constructing a student project that will be interfaced to a microprocessor, using D/A and A/D converter. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 1 and 2* *Standard* *Performance rating of 3 for each applicable task*	40
• connect a microprocessor to a sensor device used in home, industrial and/or transportation applications	• locating, researching, experimenting or constructing a device to be connected to a microprocessor • writing a program to accept data and return data to a device such as: – photo resistor – temperature and optical sensors – photo diodes and photo transistors – optocouplers – Hall effect devices – DC stepper motors	35

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<table>
<tr><th>Module Learner Expectations</th><th>Assessment Criteria and Conditions</th><th>Suggested Emphasis</th></tr>
<tr><td>The student will:</td><td>Assessment of student achievement should be based on:
• constructing, connecting, interfacing and operating a microprocessor devices such as:
– robots
– weather stations
– home environment systems
– security systems
– automotive
– data transmission.
Assessment Tool
ELTLAB–3: Assessment Checklist: Laboratory Practice, Part 2
Standard
Performance rating of 3 for each applicable task</td><td></td></tr>
<tr><td>• demonstrate established laboratory procedures and safe work practices</td><td>• observed performance in following:
– established laboratory procedures
– procedures indicating awareness of voltage/current transients.
Assessment Tool
ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices
Standard
Performance rating of 3 for each applicable task</td><td>5</td></tr>
<tr><td>• demonstrate basic competencies.</td><td>• observations of individual effort and interpersonal interaction during the learning process.
Assessment Tool
Basic Competencies Reference Guide and any assessment tools noted above</td><td>Integrated throughout</td></tr>
</table>

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • describe voltage/current transients in real-world applications that connect to low voltage computers • safely interface computers to real-world applications.	Spikes, Surges, Static, Counter EMF.

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals	• describe the basic difference between system boards • outline the memory allocations in a typical microcomputer system using RAM, ROM, EPROM, EEROM and I/O • define input/output as they apply to microprocessors • state the two main methods of I/O operation in microprocessors • describe a simplified microprocessor interface device • define the term interrupt • explain the bus structure of a typical microprocessor system • explain three-state logic • draw a simplified block diagram of an interface device and explain the purpose of the data, control and data direction registers • write a simple program that will configure an interface device in any I/O combination • describe how serial data can be represented using both amplitude and frequency modulation techniques • explain the difference between asynchronous and synchronous serial data transmission • explain how to interface a ROM, EPROM or RAM • define the difference between a UART, BSRT and USART device • write and execute a program to convert serial data to parallel and parallel to serial.	A microprocessor trainer and interfacing application trainer may be used to complete these SLEs. Several CAI packages are available that work through similar SLEs.

Concept	Specific Learner Expectations	Notes
Real-world Applications	*The student should:* • research/experiment with some of the following concepts that apply to microprocessors: – interface a D/A converter to a microprocessor system – describe how D/A converters are used to control the direction of rotation, speed and position of DC motors – define the function of a servo amplifier in a motor control circuit – describe and provide an example of a microprocessor-based industrial control system – construct a microprocessor-controlled thermometer – construction a microprocessor-controlled SCR or TRIAC circuit – explain how a microprocessor can control the effective current to a load using an SCR or TRIAC – state the advantages of using an opto-isolator in a microprocessor control circuit – design, construct and explain a microprocessor/stepper motor interface and control circuit – explain how a microprocessor is used to control exhaust emissions and fuel economy in an automobile – explain how microprocessors can be used to control a robot • list several consumer product applications of a microprocessor • explain how multiple microprocessors are used in advanced personal computer and business systems • describe several microprocessor applicators in the aviation and medical industries • explain several business applications of microprocessors including computers, word processors, copiers/printers, registers and inventory control.	

Concept	Specific Learner Expectations	Notes
Designing and Prototyping	*The student should:* • construct, connect, interface and operate a microprocessor with devices such as: – photo resistive – temperature and optical sensors – photo diodes and photo transistors – optical interrupter and optical reflectors – optocouplers – Hall effect devices – DC motors	
	• construct a project incorporating a microprocessor/microcontroller to control the operation; e.g.: – robots – weather stations – home environment systems – security systems – automotive applications – modems	Could be linked to ELT2010, ELT3010 and robotics for printed circuit.
	• construct a project using EPROM's memory and various interface devices.	

MODULE ELT3100: ANALOG COMMUNICATION 3

Level: Advanced

Theme: Communication Systems

Prerequisite: ELT2090 Analog Communication 2

Module Description: Students demonstrate the principal concepts of electronic analog communication systems.

Module Parameters: CAI package or ham/radio kits and related resources.

Supporting Modules: ELT2100 Radio Communication
ELT2080 Control Systems 2

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • identify and demonstrate applications of analog communication	*Assessment of student achievement should be based on:* • analyzing the following electronic circuits: – detection, clamping, filtering circuits – bipolar transistors operation configurations – power, voltage, current amplification – FET circuit arrangements – applications of unijunction transistors – opto-electric devices – operational amplifiers – feedback oscillators – LC oscillators – SSB – amplitude, frequency modulator and AM/FM detectors using a computer simulation package. • testing the following components: – diodes (rectifiers, zener, tunnel, light emitting, photo, etc.) – transistors (bipolar, unijunction, FET, etc.) – operational amplifiers – passive and active devices using test instruments such as multimeters, transistor checkers, signature analysis, oscilloscopes.	70

MODULE ELT3100: ANALOG COMMUNICATION 3 (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:* • analyzing advanced communication circuits such as: – FM transmitters/receivers – infrared transmitter/receiver – analog filters – oscillators – amplitude, frequency modulator – dial tone dual tone multifrequency (DTMF) – basic telephone set using computer simulation, experimental boards, CAI packages or trainers. • constructing communication project, such as: – telephone enhancements – radio receiver projects – ham radio kit – infrared transmitter/receivers. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	
• explain differences between analog communication circuit applications used in telephone systems and consumer audio equipment	• explaining the differences between various analog communication circuits used in applications such as: – consumer stereo systems – PA sound systems – telephones – telephone switching networks – cellular telephones – multiband receivers – intercom systems – television – cable television – video cassette recorder (VCR). *Assessment Tool* *ELTLAB-2: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	20

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – procedures indicating awareness of transformer input/output ratings – procedures indicating awareness of heat sinks – correct use of soft fuses for equipment protection. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• create a profile of a trade or occupation within the field of analog communication	• completing a career profile in the field of analog communication. *Assessment Tool* *ELTCPC: Assessment Guide: Career Profiles* *Standard* *Completing all sections of the profile chart*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• describe transformer input/output ratings • describe heat sinks • demonstrate knowledge of fuse ratings • demonstrate use of isolation transformers • use "soft fuses" to protect equipment • demonstrate correct handling of electronic components • use correct electronic test equipment.	RF frequency burns above one watt. Light bulb inserted in fuse holder.

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals	• explain such terms as: – sine wave – distortion – harmonic signals – amplification – noise – impedance – signal losses – crosstalk – carrier modulation, demodulation – amplitude modulation – frequency modulation – stereo – multichannel communication	This module may be linked to ELT2010: Electro-assembly 2 and ELT3010: Electro-assembly 3.
	• draw a block diagram of multiband receivers	
	• break down diagrams using complex waveforms into their component parts	
	• explain the block diagram operation of a telephone call from the local subscriber to distant subscriber to involve equipment and transmission lines in between	Reference: *Modern Electronics* (Miller).
	• draw a block diagram of a telephone receiver	
	• contrast the fundamental differences between: – amplitude modulation (AM) – frequency modulation (FM) – single side band (SSB)	AM, FM and Shortwave Frequency.
	• analyze the function of each block of multiband receiver	The intent of this SLE is to encourage students to develop a strong, analog communication fundamental knowledge base.
	• define the properties of signals in both acoustic and electrical forms	
	• identify the distinction used to clarify analog versus digital techniques used in creating electrical signals	

Concept	Specific Learner Expectations	Notes
	The student should:	
Fundamentals (continued)	• describe and measure signal frequency, wavelength and phase • apply the terms and formulas of basic AC to electrical signals • use basic terminology to describe signal power, calculate power gain and show how dB units are converted to voltage, current and power ratios • describe the general operating characteristics of oscillator circuits used to generate sine wave signals • define the concepts of frequency response—power versus frequency—for telephone and audio equipment • state the signal-to-noise ratios required for reliable communications within telephone and audio systems	CAI packages may be appropriate at this level to cover all the topics. For students who require additional time or who delve into the material, link this module with a Career Transition module.
	• specify the common forms of wave form distortion applied to signals that pass through electronic circuits • relate the concepts of harmonic distortion and frequency generation to telephone, audio and other telecommunication systems identify the operating characteristics of a complex stereo receiver from previous block diagrams • specify and identify the dial tone dual tone multifrequency (DTMF) • identify the operating principles of a basic electronic telephone set.	Text: *Understanding Telephone Electronics* 3rd edition (Stephen J. Bigelow).

Concept	Specific Learner Expectations	Notes
Designing and Prototyping	*The student should:* • research and construct a communication project, incorporating some of the following: – diodes, rectifier, zener, tunnel, etc., (used in detection, clamping, filtering circuits) – bipolar transistors operation (used in three-basic transistor configurations) • list circuit arrangements preferred for power amplification, voltage amplification, current amplification, polarity inversion, impedance matching, isolation and frequency operation • identify three basic field effect transistor (FET) circuit arrangements: – identify applications of unijunction transistors • identify opto-electric devices used in communication analog electronic circuits • analyze simple inverting and non-inverting amplifiers using operational amplifiers • list the three general classes of feedback oscillators • calculate the frequency of common LC oscillators • explain the advantages, disadvantages and characteristics of amplitude modulation, SSB and frequency modulation • explain the operation of a basic amplitude modulator, balanced modulator, frequency modulator and AM and FM detectors.	A number of methods may be used: • traditional laboratories • textbooks, videos • computer-aided instruction • computer-aided trainers • computer-aided troubleshooting. (Using different methods would keep up student interest and motivation. Students who require additional time to complete this SLE may link this module to a Career Transitions module.) Ideas for this SLE can be obtained from the following reference: • *Incredible Audio and Video Projects You Can Build* (Rudolf F. Graf, William Sheets). Texts that may be used are *Ready To Build Telephone Enhancement* (Delton J. Horn).

MODULE ELT3100: ANALOG COMMUNICATION 3 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Fabricating/Testing	• analyze one of the following according to project chosen and student interest: – measure input, output analog signals of various transducers – prototype and construct a simple transmitter and/or receiver using transistors and OP amps – prototype an infrared transmitter/receiver for analog transmission – develop, test and measure various signals as they pass through various analog filters – prototype of light wave code transmitters and receivers – prototype of simple diode receivers – construct a simple oscillator – develop an active filter using OP amps.	References: *Modern Electronic Communication* (Gary M. Miller), and Lab Manual, 4th edition (Mark Oliver). *Communication Electronics*, Louis Frenzel. *Activities Manual for Communication Electronics* (Louis E. Frenzel).
Careers	• research the differences in education, training and job function for electrical engineers, technologists and technicians • research various careers involved in communication electronics • research topics covered in a post-secondary institution that has an communication electronics program.	College, technical institution, apprenticeship. Calendars.

MODULE ELT3110: AMPLIFIERS

Level: Advanced

Theme: Communication Systems

Prerequisite: ELT3100 Analog Communication 3

Module Description: Students demonstrate knowledge of various types and classes of amplifiers.

Module Parameters: CAI package, assorted types of amplifiers and related resources.

Supporting Modules: ELT2050 Electronic Power Supply
ELT3100 Analog Communication 3

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • explain the differences among various types and classes of amplifiers	*Assessment of student achievement should be based on:* • describing the application of various amplifiers such as: – class A, class AB, class B, class C – operational amplifiers (OP amps) – metal-oxide semiconductor field effect transistors (MOSFETs) and junction field effect transistors (JFETs) – direct current (DC) amplifiers – Darlington-pair amplifiers – integrated current (IC) amplifiers • explaining the difference between amplifiers, using the following criteria: – transistor circuit configuration – impedance matching (input/output) – multistage – types of coupling – voltage and power gain in decibels (dB) • identifying and explaining amplifiers using the following terms: – complementary – push-pull – symmetry and using schematic and block diagrams generated by the student or obtain from reference sources or computer simulation programs. *Assessment Tool* *CTSPRE: Assessment Framework: Presentations/Reports* *Standard* *Performance rating of 3 for each applicable task*	20

MODULE ELT3110: AMPLIFIERS (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • construct, analyze and test amplifier circuits and components	*Assessment of student achievement should be based on:* • testing of the following components – capacitor – transformers – transistors (uni- and bi-polar) – operational and amplifiers – MOSFETs, FETs and JFETs – audio power ICs • using multimeters, oscilloscopes, transistor checkers, Db meters, signal generators and signature analysis, analyzing the following amplifier circuits: – Class A amplifier – complementary Class B amplifier – Class B push-pull circuit – Class AB amplifier – RC-coupled amplifier – JFET common drain amplifier – JFET common gate amplifier using computer simulation, CAI packages or actual devices • experimenting with amplifier circuits and mini circuits that use operational amplifiers, differential amplifiers, Darlington-pairs, etc. • constructing a 25/30 watt amplifier (audio or video). *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 1 and 2* *Standard* *Performance rating of 3 for each applicable task*	55
• maintain, test and troubleshoot a power amplifier	• troubleshooting and repairing or maintaining a consumer stereo power system. *Assessment Tool* *ELTCS–1: Assessment Guide: Customer Service, Parts 1 and 2* *Standard* *Performance rating of 3 for each applicable task*	20

MODULE ELT3110: AMPLIFIERS (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate established laboratory procedures and safe work practices	*Assessment of student achievement should be based on:* • observed performance in following: – established laboratory procedures – proper handling of solid-state components – correct installation of transistor on heat sinks. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• demonstrate basic competencies.	• observing individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • demonstrate how to: – measure voltage and current in an amplifier – handle solid-state components – use electronic test equipment – install transistors using heat sinks.	

Concept	Specific Learner Expectations	Notes
Fundamentals/ Applied Mathematics	*The student should:* • define such terms as: – biasing – class A, AB, B, C amplifiers – common emitter amplifier – common collector circuit configuration – common base circuit configuration – impedance matching – capacitor coupling – multistages – bypass capacitors – inverting and non-inverting amplifiers – operational amplifiers – MOSFETs – JFETs • explain the function and operation of DC, audio, video, power, RF and IF amplifiers • describe a Darlington-pair arrangement • explain how a differential amplifier operates • identify three different types of power amplifiers • explain how volume and tone can be controlled in an audio amplifier • explain the basic differences between IF and RF amplifiers • list three ways of increasing the bandwidth in RF and IF amplifiers • draw a block diagram of a multistage audio amplifier • describe the operation of operational amplifiers using inverting and non-inverting circuits • choose the appropriate amplifier configuration for an application • calculate voltage gain and power gain in decibels (dB).	UCANDO Videos: *Amplifiers.*

MODULE ELT3110: AMPLIFIERS (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Designing and Prototyping	• construct and experiment with amplification circuits such as: – DC amplifier – Class A amplifier – complementary Class B Amplifier – Class B push-pull circuit – Class AB amplifier – a two-stage, RC-coupled audio amplifier – a basic audio power amplifier – push-pull power amplifier – IC amplifiers used in large audio system, e.g., car cassette systems, consumer audio systems – use a JFET as a common-drain amplifier – use a JFET as a common-gate amplifier – a basic differential operational amplifier.	Students may use traditional laboratory methods or any CAI amplifier package. Additional time may be required. Link this with a Career Transitions module.
Real-world Applications/ Troubleshooting	• troubleshoot a multistage common-emitter amplifier to determine which amplifier stage is faulty.	Additional time may be required. Link this with a Career Transitions module.
Fabricating/Testing	• construct a 25 watt amplifier project (audio or video) • evaluate completed project.	Additional time may be required. Link this with a Career Transitions module. References: • *Incredible Audio and Video Projects You Can Build* (Rudolf F. Graf William Sheets) • *Electronic Power Control* (Irving Gottlieb).

MODULE ELT3130: DATA/TELEMETRY SYSTEMS

Level: Advanced

Theme: Communication Systems

Prerequisite: ELT2100 Radio Communication

Module Description: Students demonstrate the fundamentals of various data/telemetry systems, and demonstrate their applications to the real world.

Module Parameters: Multimeters (analog/digital), function generator, oscilloscope and related resources. Optional equipment: computers, satellite receiver, special trainer or simulators.

Supporting Module: ELT3100 Analogue Communication 3

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • distinguish the difference between analog and digital carriers with voice or data transmission	*Assessment of student achievement should be based on:* • explaining the differences between the following data/telemetry concepts: – analog link versus digital link – digital and data communication – pulse code modulations (PCM) and pulse amplitude signal (PAM) – frequency shift keying (FSK), phase shift keying (PSK) and quadrative amplitude modulation (QAM) – carrier and character synchronization – synchronous and asynchronous modems – scrambler and descrambler techniques – circuit message network and packet switching network. *Assessment Tool* *CTSPRE: Assessment Framework: Presentations/Reports* *Standard* *Performance rating of 3 for each applicable task*	20

<table>
<tr><th>Module Learner Expectations</th><th>Assessment Criteria and Conditions</th><th>Suggested Emphasis</th></tr>
<tr><td>The student will:
• explain data/telemetry communication through experimentation, circuit analysis and project work</td><td>Assessment of student achievement should be based on:
• using advanced data/telemetry circuits such as:
– digital sampling unit
– parity bit checker and detector
– digital to analog (D/A) or analog to digital (A/D) converters
– pulse-amplitude modulation
– time division multiplexing
• using computer simulation, experimental boards, CAI package or trainers to analyze the following data/telemetry concepts:
– a function generator and observe how it can be used to encode digital information onto an FSK signal
– an FSK decoder and observe how it can be used to convert a FSK signal back into a digital data
– a PAM communication system that uses time division multiplexing
– ongoing observed performance in the construction of an advanced data/telemetry project of student choice.
Assessment Tool
ELTLAB–2: Assessment Checklist: Laboratory Practice, Parts 1 and 3
Standard
Performance rating of 3 for each applicable task</td><td>55</td></tr>
<tr><td>• construct a voice or data transmission network</td><td>• constructing or installing one of the following data networks:
– star
– ring
– multidrop
• constructing or installing one of the following voice transmission networks:
– simplex
– half-duplex
– full-duplex.
Assessment Tool
ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 2
Standard
Performance rating of 3 for each applicable task</td><td>20</td></tr>
</table>

MODULE ELT3130: DATA/TELEMETRY SYSTEMS (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • observe established laboratory procedures and safe work practices	*Assessment of student achievement should be based on:* • observed performance in following: – established laboratory procedures – demonstrated awareness of current and voltage levels in communication networks – proper handling of IC and other electronic components. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Safety/Resource Management	*The student should:* • identify voltage and current levels in communication networks • explain how to correctly handle IC and other electronic components • investigate the standards developed by EIA for electronic communication.	
Fundamentals	• define the following terms: – digital signal – duty cycle – sampling – coding – multiplexing – encoding – telemetry	

Concept	Specific Learner Expectations	Notes
Fundamentals (continued)	*The student should:* – radio telemetry – converter – carrier – modulator – error detection – modem – analog link versus digital link • research the following networks: – star – ring – multidrop • describe the difference between the following communication systems: – simplex – half-duplex – full-duplex – full/full-duplex • explain the difference between digital and data communication • describe how a wave may be sampled • draw a block diagram of a radio-telemetry system and describe each part of the system • draw a block diagram and explain each part in the following transmission alternatives: – standard continuous modulation – telegraphy – pulse modulation – pulse code modulation • explain pulse code modulation (PCM) • sketch the wave form of a pulse amplitude signal (PAM) • explain why PCM is strictly the only true digital system of the four above • draw a block diagram of a computer data transmission system	Evolution of data transmission systems.

Concept	Specific Learner Expectations	Notes
Fundamentals (continued)	*The student should:* • explain a universal asynchronous receiver/ transmitter (UART) device • describe the difference between the following forms of modulation by modems: – frequency shift keying (FSK) – phase shift keying (PSK) – quadrative amplitude modulation (QAM) • describe three types of synchronization that must be accomplished: – carrier – bit – character • explain how a modem transmits data if it were: – synchronous – asynchronous • explain line protocol • explain how error detection and correction is achieved in digital data communication • explain the difference between scramblers and descramblers • explain the difference in a network between circuit message and packet switching • explain frequency division multiplexing (FDM) in a modem • research the type of local area network (LAN) his or her school uses • list and explain the pin functions on an RS232C interface • list the two broad categories of pulse modulation • name the two types of analog pulse modulation • state the sampling Nyquist rate theorem • compare analog and digital pulse modulation. • construct a digital sampling unit (frequency counter)	Name the basic types of multiplexing and define each one.

MODULE ELT3130: DATA/TELEMETRY SYSTEMS (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Fabricating/Testing	• construct an error detector in data transmission—parity bit checker and detector • prototype, experiment with a basic D/A converter and A/D converter ICs • construct a simple circuit using a UART device • analyze a function generator and observe how it can be used to encode digital information onto an FSK signal • analyze an FSK decoder and observe how it can be used to convert an FSK signal back into a digital data • describe pulse-amplitude modulation techniques • test and evaluate a simple PAM modulator and demodulator • test and evaluate a PAM communication system that uses time division multiplexing • construct a simple circuit that uses analog data, convert it to digital pulses and reproduce at the output the original analog signal • install a modem and check operation • construct a project using a UART IC • install a network between several computers • research scrambling and descrambling techniques used by local cable companies • construct an elementary gated five-jack descrambler • prototype a sine-wave decoder • construct an advanced video project • construct a telephone scrambler.	*Miller's Laboratory Manual for Modern Electronic Communication.* *Communications Electronics,* 2nd edition (Louis E. Frenzel). This circuit is for experimental and education use only. For experimental and education use only.
Ethics	• report on political, legal and consumer aspects of cable TV descrambling/scrambling.	

MODULE ELT3140: MOTORS

Level: Advanced

Theme: Robotic and Control Systems

Prerequisite: ELT2080 Control Systems 2

Module Description: Students demonstrate knowledge of electric motor operation and loading characteristics.

Module Parameters: AC/DC motors (single-phase AC motor and DC motors) and related resources.
Note: The student must have access to instruction from an individual with Electrical Technologist or journeyman status when students are performing practical components other than low voltage.

Supporting Modules: ELT2130 Magnetic Control Devices
ELT3040 Generation/Transformation

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain electromotive principles as applied to direct current (DC) and single-phase alternating current (AC) motors	• explaining the electromotive principles of both a DC motor and an AC single-phase motor. *Assessment Tool* *ELT3140–1: Presentation/Reports, Electric Motors* *Standard* *Performance rating of 3 for each applicable task*	15
• explain the operational characteristics of common DC and AC motors	• describing the operating characteristics of: – DC series motor – DC shunt motor – DC compound motor – single- and/or three-phase commutator motors – single- and/or three-phase induction motor – single- and/or three-phase synchronous. *Assessment Tool* *ELT3140–1: Presentations/Reports: Electric Motors* *Standard* *Performance rating of 3 for each applicable task*	20

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• set up selected DC and AC motors, and demonstrate their loading characteristics	• collecting data to graph the operating characteristics of the following motors: – DC compound motor – single- and three-phase commutator motors – single- and three-phase induction motor – single-phase synchronous. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	55
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – proper wiring practices – correct loading and operating procedures. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• create a profile of a trade or occupation within the field of electric motors	• completing a career profile chart related to servicing/repairing electric motors. *Assessment Tool* *ELTCPC: Assessment Guide: Career Profiles* *Standard* *Completing all sections of the profile chart*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

<table>
<tr><th>Concept</th><th>Specific Learner Expectations</th><th>Notes</th></tr>
<tr><td>Safety/Resource Management</td><td>The student should:
identify and follow safe wiring practices
use protection devices for all circuits
describe dangers of shaft rotation regarding:
– vibration
– long hair
– clothing
– jewelry.</td><td>Use of overload and overcurrent devices.

Live voltage projects must be activated through GFI circuit breaker.

When instructional journeyman qualifications restrict high voltage use, projects may be done in low voltages (less than 30 volts).</td></tr>
<tr><td>Fundamentals</td><td>explain and demonstrate motor principles:
– counter EMF
– inductance
– conductive resistance
describe and explain characteristics of the following AC and DC motors:
– shaded pole
– split phase
– capacitive start and run
– three-phase
– universal
– single-phase synchronous
– stepper
– servo
– permanent magnet.
describe methods of DC motor control:
– pulse width modulations (PWM)
– positional feedback/shaft encoding
explain nameplate ratings:
– voltage
– current
– horsepower
– efficiency
– cycle
– RPM
– phase
– frame size
– enclosure.</td><td>Power small DC hobby motor with PWM circuit using 555 timer circuit Reference Industrial Electronic by Petruzella.</td></tr>
</table>

Concept	Specific Learner Expectations	Notes
	The student should:	
Designing and Prototyping	• design and construct the following motor circuits to find torque versus load and speed regulation versus load on: – inductive motors: • split phase • capacitor start • permanent split capacitor • shaded pole • three-phase – brush motors: • universal • flat compound DC motor – others: • single-phase synchronous • stepper • servo • permanent magnet.	Starting current. Rotation. Drives in electronic components. Small hobby motor projects, e.g., solar cars and robots.
Careers	• research careers that require knowledge of electric motors.	Oil/gas industry. Computer processor control. Manufacturers—assembly line. Printing presses. Elevators.

MODULE ELT3150: ROBOTICS 3

Level: Advanced

Theme: Robotic and Control Systems

Prerequisite: ELT2140 Robotics 2

Module Description: Students demonstrate remote/autonomous control systems, by constructing circuits to control robotic behaviour.

Module Parameters: CAI robotics package, robotic trainer, surplus electromechanical components (optional) and related resources.

Supporting Modules: ELT2100 Radio Communication
ELT3090 Microprocessor Interface

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and assemble the required components to build a frequency remote control or microprocessor control for a robotic unit	• designing and building a frequency remote or micro-processor control robotic unit to include: – schematic diagrams – pictorial PC board layout diagrams – foil PC board layout diagram – bill of materials – assembly instruction – construction of unit – testing unit operation. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 2* *ELTPAF: Project Assessment Form* *Standard* *Performance rating of 3 for each applicable task*	55
• identify various microprocessor control systems and subsystems used in robotic units	• identifying and creating block diagrams of microprocessor control systems and sub-systems and devices that demonstrate various microprocessor control systems and subsystems. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	10

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain frequency control or microprocessor control circuits and components in robotic units	• creating block diagrams showing how the frequency or microprocessor control circuits and components function in a robotic unit. *Assessment Tool* *ELTLAB–2: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	15
• operate a robotic system that has various feedback controls	• operating and explaining feedback control circuit(s) in a constructed robot. *Assessment Tool* *ELTLAB–1: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	10
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – correct procedures for operation of robots within designed tolerance. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• create a profile of a trade or occupation within the field of robotics	• completing a career profile chart related to robotics. *Assessment Tool* *ELTCPC: Assessment Guide: Career Profiles* *Standard* *Completing all sections of the profile chart*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

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MODULE ELT3150: ROBOTICS 3 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• identify and follow safe wiring practices when working with RF • use protection devices for all circuits • operate robotic systems within design tolerances.	RF fusing temperature cutoff.
Fundamentals	• demonstrate the principles of either a remote frequency control or a programming address code control • explain the operation of the electronic components and circuit used to build either a remote control robot or a programmable control robot.	
Systems Identification	• draw and explain the various blocks in either a remote control system or programmable microprocessor/control system • describe and explain use of sight, sound and tactile sensor control systems with either the remote control system or the programmable microprocessor control system • explain the fundamentals of either the remote control system or the programmable microprocessor control system controlling the motor drives in the robotic system • identify the differences between remote control systems and a programmable control system on how the robot gains information about its environment • explain how sensor controls help either the remote control or the programmable control robot to receive feedback from the environment.	Use electronics simulation packages.

Concept	Specific Learner Expectations	Notes
Designing and Prototyping	*The student should:* • demonstrate knowledge of either a remote control or a programmable control system by building either a remote control or a microprocessor control for a mobile robot system • prototype either a remote control system or a programmable control system and construct the circuit so that either the remote control or the programmable control controls the motors on the mobile robot • draw the schematic diagram of the printed circuit board and wiring schematic of the control circuitry.	Surplus electro-mechanical components. Robot kit.
Fabrication	• assemble electronic components to build a mobile robot • build either a remote control or a programmable control and mount either control on the mobile robot.	Refer to: *Mobile Robots* (J.L. Jome and A. Flynn), *Robot Builder's Bonanza, 99 Inexpensive Robotic Projects* (Gordon McComb), *Western Canadian Robot Games* (Southern Alberta Institute of Technology).
Real-world Applications	• research the benefits and drawbacks of various remote and/or microprocessor controls that are used to operate a robot • describe where industry is making use of remote and microprocessor control robots.	Tour an industrial plant using robots.
Careers	• research career opportunities in the robotic field.	

MODULE ELT3160: CONTROL APPLICATIONS

Level: Advanced

Theme: Robotic and Control Systems

Prerequisite: ELT2150 Electronic Controls

Module Description: Students demonstrate the fundamentals of programmed controls, and demonstrate how sensing devices are integrated to control output devices.

Module Parameters: Program Logic Controller, associated input/output devices and related resources.
Note: The student must have access to instruction from an individual with Electrical Technologist or journeyman status when students are performing practical components other than low voltage.

Supporting Modules: ELT2130 Magnetic Control Devices
ELT3140 Motors

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe input and output hardware components and the methods of programming	• identifying and describing two types of input devices, digital and analog input hardware components and explaining how each is used in a program • explaining advance programming functions such as: – timers and counters – data manipulation instructions – shift register and sequencer instruction and explain how each is used in programming a programmer logic controller (PLC). *Assessment Tool* *ELTLAB-2: Assessment Checklist: Laboratory Practice, Part 1* *Standard* *Performance rating of 3 for each applicable task*	20
• use programming logic, including real or programmed inputs, to control electromagnetic devices	• drawing, identifying and writing a housing address, ladder logic and wiring diagram	60

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:* • fabricating, constructing and testing programmed logic to operate and control electromagnetic devices connected to a PLC. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Part 2* *Standard* *Performance rating of 3 for each applicable task*	
• use various instruction codes to operate and control electromagnetic devices	• changing instructional codes of input devices that the logic program uses to operate and control the electromagnetic devices connected to the PLC. *Assessment Tool* *ELTLAB–3: Assessment Checklist: Laboratory Practice, Parts 2 and 3* *Standard* *Performance rating of 3 for each applicable task*	15
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – correct use of protection devices for circuits. *Assessment Tool* *ELTPSP: Assessment Checklist: Laboratory Procedures and Safety Practices* *Standard* *Performance rating of 3 for each applicable task*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Safety/Resource Management	• identify and follow safe wiring practices when wiring the input and output circuits • use protection devices for all circuits.	Low voltage wiring, grounding, separation of voltages, fusing. Live voltage projects must be activated through GFI circuit breaker. When instructional journeyman qualifications restrict high voltage use, projects may be done in low voltages (less than 30 volts).
Fundamentals	• draw and identify addressing, ladder logic and wiring diagram of a PLC installation • describe and explain numbering systems and codes for internal logic control • plan PLC ladder programs and wiring diagrams, advance programming logic functions • create flow diagram to write programming logic • compare relay logic and PLC programming • demonstrate principles of electromagnetic motor starters to control large current flow to output devices • demonstrate principles of feedback loop input sensors to protect outputs devices • demonstrate the action of overload and limit switch feedback loop input sensors to protect the output system • demonstrate knowledge of how either a DC or an AC motor is operated by a PLC • demonstrate knowledge on how A/D conversions are done on a PLC.	
System Identification	• identify the difference between real-world devices and internal program devices when programming the PLC.	

Concept	Specific Learner Expectations	Notes
Real-world Applications	*The student should:* • research the benefits and drawbacks of using PLCs • research how PLCs are used in computer integrated manufacturing.	
Fabricating/Testing	• build a multiple motor, PLC-controlled installation, and write a program to control the installation.	Low voltage hobby motors.
Design/Prototyping	• demonstrate a knowledge of PLC function by writing advance programs to operate a relay controlled AC motors • design programming functions with input and output devices so the PLC can control electromagnetic devices and indicator lamps • draw PLC ladder programs complete with wiring diagrams of input and output systems.	
Careers	• write a report on industries that use PLCs to control and monitor computer integrated manufacturing.	

ELECTRO-TECHNOLOGIES

SECTION G: ASSESSMENT TOOLS

The following pages comprise background information and strategies for assessing student achievement and the assessment tools that are listed in Sections D, E and F of this Guide.

This section of the Guide to Standards and Implementation has been designed to provide a common base of understanding about the level of competencies students are expected to demonstrate to successfully complete a module. The goal is to establish assessment standards for junior and senior high school students that are fair, credible and challenging.

These tools will assist teachers throughout the province to more consistently assess student achievement. The purpose of expanding on the assessment standards is to:

- increase confidence among students, parents, business/ industry and post-secondary that students can demonstrate the competencies specified in the modules they have completed
- encourage fairness and equity in how students' efforts are judged
- enable learners to focus effort on key learnings
- support teachers and community partners in planning and implementing CTS.

These tools were validated during the optional stage of CTS implementation.

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ELT2070–1: Presentations/Reports: Computer Systems G.33
ELT2080–1: Presentations/Reports: Process Controls G.34
ELT2090–1: Presentations/Reports: Analog Communication Systems G.35
ELT2100–1: Presentations/Reports: Electromagnetic Communication Systems G.36
ELT2110–1: Presentations/Reports: Security Systems G.37
ELT2120–1: Presentations/Reports: Lasers and Fibre Optics G.38
ELT2140–1: Presentations/Reports: Robotic Sensor Controls G.39
ELT2150–1: Presentations/Reports: Programmable Controls G.40
ELT3010–1: Presentations/Reports: Printed Circuit Boards G.41
ELT3020–1: Presentations/Reports: Electronic Service and Repair G.42
ELT3040–1: Presentations/Reports: Power Generation and Transformation G.43
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ASSESSING STUDENT ACHIEVEMENT IN CTS

The CTS assessment standards assess two basic forms of competency:

- What can a student ***do***?
  - **make** a product (e.g., wood bowl, report, garment)
  - **demonstrate** a process
    - strand-related competencies (e.g., keyboarding, hair cutting, sewing techniques, lab procedures)
    - basic competencies (e.g., resource use, safety procedures, teamwork).
- What does a student ***know***?
  - knowledge base needed to demonstrate a competency (link theory and practice).

CTS Defines *Summative* Assessment Standards

The assessment standards and tools defined for the CTS modules, referenced in Sections D, E and F of this Guide, focus on the final (or summative) assessment of student achievement.

Assessment throughout the learning period (formative assessment) will continue to evaluate how students are progressing. Teachers direct and respond to students' efforts to learn—setting and marking tasks and assignments, indicating where improvement is needed, sending out interim reports, congratulating excellence, etc.

Teachers will decide which instructional and assessment strategies to apply during the formative learning period. As formative and summative assessment are closely linked, some teachers may wish to modify the tools included in this section to use during the instructional process. Teachers may also develop their own summative assessment tools as long as the standards are consistent with the minimum expectations outlined by Alberta Education.

Grading and Reporting Student Achievement

When a student can demonstrate ALL of the exit-level competencies defined for the module (module learner expectations), the teacher will designate the module as "successfully completed." The teacher will then use accepted grading practices to determine the percentage grade to be given for the module—a mark not less than 50%.

The time frame a teacher allows a student to develop the exit-level competency is a local decision. NOTE: The Senior High School Handbook specifies that students must have access to 25 hours of instruction for each credit. Students may, however, attain the required competencies in less time and may proceed to other modules.

Teachers are encouraged to consult their colleagues to ensure grading practices are as consistent as possible.

High school teachers may wish to refer to "Directions for Reporting Student Achievement in CTS" for information on how to use the CTS course codes to report the credits that students have earned to Alberta Education. (Copies of this document have been forwarded to superintendents and senior high school principals.)

Components of Assessment Standards in CTS

The following components are included in each module:

- **module learner expectations** (in the shaded left column of the module) define the exit-level competencies students are expected to achieve to complete a module. Each MLE defines and describes critical behaviours that can be measured and observed. The student must meet the standard specified for **ALL** MLEs within a module to be successful.
- **suggested emphasis** (in the right column of the module) provides a guideline for the relative significance of each MLE and can be used to organize for instruction.

- **criteria and conditions** (in the middle column of the module) set the framework for the assessment of student competency, specifying the minimum standard for performance and including a reference to assessment tools, where appropriate.

  Criteria define the behaviours that a student must demonstrate to meet the designated standard. For example, the criteria could describe the various techniques that must be demonstrated when using a tool, and/or describe the minimum components of a project the student must complete.

  Conditions outline the specifications under which a student's competency can be judged. For example, the conditions could specify whether the assessment should be timed or not, or if the student should be allowed to access to support resources or references.

  Standard may be defined by (1) assessment tools, which are referenced in this section (or sometimes in approved learning resources) and/or (2) "illustrative examples" of student work, if appropriate.

  Assessment Tools included in this section of the Guide tend to be of two types:

  - tools generic to a strand or to the entire CTS program; e.g., a standard five-point rating scale is used in all strands. Other generic tools include assessing reports and presentations and lab safety checklists. (*Names of these tools include the strand code [e.g., "INF" for Information Processing] and a code for the type of tool [e.g., "TDENT" for Text-Data Entry].)*
  - tools specific to a module; e.g., assessment checklist for assessing a venture plan in Enterprise and Innovation or a checklist for sketching, drawing and modelling in Design Studies. *Names of these tools include the module code; e.g., "INF1010–1" indicating that it is the first module-specific tool used in Information Processing Module 1010.*

Development and Validation Processes

The "Criteria and Conditions" and "Suggested Emphasis" columns have been validated with extensive input from teachers, professional associations/contacts and post-secondary institutions. The goal was to prepare well-structured assessment standards and related assessment tools that:

- establish an appropriate level of challenge and rigour
- relate directly to the type of learning described in the curriculum standard
- are easy to understand
- are efficient to implement
- can provide a consistent measure of what was expected to be measured.

As students and teachers work with the assessment standards and tools, it is expected that levels of performance will increase as more and more students are able to achieve the minimum standard. Therefore, the assessment standards and related tools will continue to be monitored, and revised as necessary to ensure appropriate levels or rigour and challenge, and successful transitions for students as they leave high school and enter the workplace or related post-secondary programs.

ASSESSING STUDENT ACHIEVEMENT IN ELECTRO-TECHNOLOGIES

The Electro-Technologies curriculum supports the principles of results-based curriculum in the way curriculum is structured, the type and range of learnings afforded to students and the manner in which they can be measured or assessed. Each module identifies criteria and conditions for each module learner expectation with a suggested emphasis within that particular module. These aspects provide for a framework for student learning and assessment with a great deal of consistency.

Assessment Strategies and Tools

In the following section, a number of different tools are provided for Electro-Technologies facilitators, either as a reference or applied for specific assessment purposes. The intent is to provide guidance to teachers in assessing student work with a standard that is fair to students and also will be recognized by stakeholder groups as valid. This will provide students with linkages to further learnings or the workplace.

In CTS, assessment tools are intended to be used for summative assessment, assessment when student has completed requirements for particular module learner expectations. Teachers will still be required to assess throughout the learning period (formative assessment) and tools can be modified to accomplish this end or new tools developed. Teachers can best gauge which instructional and assessment strategies to apply during the formative learning period.

Tools Generic to CTS

The generic rating scale has been used to develop several of the tools in CTS. A generic framework for assessing the processes CTS students apply in completing a task or project is included in this section. It is based on the notion that students will follow a process as they work through their projects and that this process has a number of sequential steps. The framework shows the increasing expectations from the introductory, to the intermediate, to the advanced level.

Tools Generic to Electro-Technologies

Generic tools have been developed for basic competencies, laboratory practice and presentation/reports, customer service and career exploration. It is intended that the basic competencies are integrated throughout the program, whereas customer service and career exploration are applied as assessment strategies dictate. The laboratory practice tools will provide specific assessment in laboratory-related learning and will assist in showing competency progression from introductory to advanced levels. Presentations/reports assessment tools are applied to theoretical components of the curriculum and provide consistency in assessing those aspects but not necessarily dictating a particular process.

Tools Specific to Electro-Technologies Modules

Tools have also been developed to assess specific MLEs in a module and are labelled with the module number and tools number (e.g., ELT–LAB101–1).

These assessment tools outline the criteria for assessment and provide the minimum standard to which the student must perform tasks or processes. It should be noted that a scale of 0–4 is used and generally the following minimum standards apply: introductory level = 1, intermediate level = 2, and advanced level = 3.

Suggested Emphasis for Assessment

The "Suggested Emphasis" column indicates to students and teachers the relative importance of each MLE in reference to the total module and assists in organizing for instruction. The basic competencies are expected to be integrated throughout and therefore the tools have been designed to assess the relevant basic competencies and the task, skill, process and/or theory. The exception to this would be when a test bank is being used. In this case it is recommended that basic competencies be assessed separately.

BASIC COMPETENCIES REFERENCE GUIDE

The chart below outlines basic competencies that students endeavour to develop and enhance in each of the CTS strands and modules. Students' basic competencies should be assessed through observations involving the student, teacher(s), peers and others as they complete the requirements for each module. In general, there is a progression of task complexity and student initiative as outlined in the Developmental Framework★. **As students progress through Stages 1, 2, 3 and 4 of this reference guide, they build on the competencies gained in earlier stages.** Students leaving high school should set themselves a goal of being able to demonstrate Stage 3 performance.

Suggested strategies for classroom use include:

- having students rate themselves and each other
- using in reflective conversation between teacher and student
- highlighting areas of strength
- tracking growth in various CTS strands
- highlighting areas upon which to focus
- maintaining a student portfolio.

Stage 1— *The student:*	**Stage 2**— *The student:*	**Stage 3**— *The student:*	**Stage 4**— *The student:*
Managing Learning			
☐ comes to class prepared for learning	☐ →	☐ →	☐ →
☐ follows basic instructions, as directed	☐ follows instructions, with limited direction	☐ follows detailed instructions on an independent basis	☐ →
	☐ sets goals and establishes steps to achieve them, with direction	☐ sets clear goals and establishes steps to achieve them	☐ demonstrates self-direction in learning, goal setting and goal achievement
☐ acquires specialized knowledge, skills and attitudes	☐ applies specialized knowledge, skills and attitudes in practical situations	☐ transfers and applies specialized knowledge, skills and attitudes in a variety of situations	☐ transfers and applies learning in new situations; demonstrates commitment to lifelong learning
☐ identifies criteria for evaluating choices and making decisions	☐ identifies and applies a range of effective strategies for solving problems and making decisions	☐ uses a range of critical thinking skills to evaluate situations, solve problems and make decisions	☐ thinks critically and acts logically to evaluate situations, solve problems and make decisions
☐ uses a variety of learning strategies	☐ explores and uses a variety of learning strategies, with limited direction	☐ selects and uses effective learning strategies	☐ →
		☐ cooperates with others in the effective use of learning strategies	☐ provides leadership in the effective use of learning strategies
Managing Resources			
☐ adheres to established timelines; uses time/schedules/planners effectively	☐ creates and adheres to timelines, with limited direction; uses time/ schedules/planners effectively	☐ creates and adheres to detailed timelines on an independent basis; prioritizes task; uses time/ schedules/planners effectively	☐ creates and adheres to detailed timelines; uses time/schedules/ planners effectively; prioritizes tasks on a consistent basis
☐ uses information (material and human resources), as directed	☐ accesses and uses a range of relevant information (material and human resources), with limited direction	☐ accesses a range of information (material and human resources), and recognizes when additional resources are required	☐ uses a wide range of information (material and human resources) in order to support and enhance the basic requirement
☐ uses technology (facilities, equipment, supplies), as directed, to perform a task or provide a service	☐ uses technology (facilities, equipment, supplies), as appropriate, to perform a task or provide a service, with minimal assistance and supervision	☐ selects and uses appropriate technology (facilities, equipment, supplies) to perform a task or provide a service on an independent basis	☐ recognizes the monetary and intrinsic value of managing technology (facilities, equipment, supplies)
☐ maintains, stores and/or disposes of equipment and materials, as directed	☐ maintains, stores and/or disposes of equipment and materials, with limited assistance	☐ maintains, stores and/or disposes of equipment and materials on an independent basis	☐ demonstrates effective techniques for managing facilities, equipment and supplies
Problem Solving and Innovation			
☐ participates in problem solving as a process ☐ learns a range of problem-solving skills and approaches	☐ identifies the problem and selects an appropriate problem-solving approach, responding appropriately to specified goals and constraints	☐ thinks critically and acts logically in the context of problem solving	☐ identifies and resolves problems efficiently and effectively
☐ practices problem-solving skills by responding appropriately to a clearly defined problem, specified goals and constraints, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ applies problem-solving skills to a directed or a self-directed activity, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ transfers problem-solving skills to real-life situations, by generating new possibilities ☐ prepares implementation plans ☐ recognizes risks	☐ identifies and suggests new ideas to get the job done creatively, by: – combining ideas or information in new ways – making connections among seemingly unrelated ideas – seeking out opportunities in an active manner

Stage 1— *The student:*	**Stage 2**— *The student:*	**Stage 3**— *The student:*	**Stage 4**— *The student:*
Communicating Effectively			
☐ uses communication skills; e.g., reading, writing, illustrating, speaking	☐ communicates thoughts, feelings and ideas to justify or challenge a position, using written, oral and/or visual means	☐ prepares and effectively presents accurate, concise, written, visual and/or oral reports providing reasoned arguments	☐ negotiates effectively, by working toward an agreement that may involve exchanging specific resources or resolving divergent interests
☐ uses language in appropriate context	☐ uses technical language appropriately	☐ encourages, persuades, convinces or otherwise motivates individuals	☐ negotiates and works toward a consensus
☐ listens to understand and learn	☐ listens and responds to understand and learn	☐ listens and responds to understand, learn and teach	☐ listens and responds to under-stand, learn, teach and evaluate
☐ demonstrates positive interpersonal skills in selected contexts	☐ demonstrates positive interpersonal skills in many contexts	☐ demonstrates positive interpersonal skills in most contexts	☐ promotes positive interpersonal skills among others
Working with Others			
☐ fulfills responsibility in a group project	☐ →	☐ seeks a team approach, as appropriate, based on group needs and benefits; e.g., idea potential, variety of strengths, sharing of workload	☐ leads, where appropriate, mobilizing the group for high performance
☐ works collaboratively in structured situations with peer members	☐ cooperates to achieve group results	☐ works in a team or group: – encourages and supports team members – helps others in a positive manner – provides leadership/ followership as required – negotiates and works toward consensus as required	☐ understands and works within the context of the group
☐ acknowledges the opinions and contributions of others in the group	☐ maintains a balance between speaking, listening and responding in group discussions ☐ respects the feelings and views of others		☐ prepares, validates and implements plans that reveal new possibilities
Demonstrating Responsibility			
Attendance			
☐ demonstrates responsibility in attendance, punctuality and task completion	☐ →	☐ →	☐ →
Safety			
☐ follows personal and environmental health and safety procedures	☐ recognizes and follows personal and environmental health and safety procedures	☐ establishes and follows personal and environmental health and safety procedures	☐ transfers and applies personal and environmental health and safety procedures to a variety of environments and situations
☐ identifies immediate hazards and their impact on self, others and the environment	☐ identifies immediate and potential hazards and their impact on self, others and the environment	☐ →	☐ →
☐ follows appropriate/emergency response procedures	☐ →	☐ →	☐ →
			☐ demonstrates accountability for actions taken to address immediate and potential hazards
Ethics			
☐ makes personal judgements about whether or not certain behaviours/actions are right or wrong	☐ assesses how personal judgements affect other peer members and/or family; e.g., home and school	☐ assesses the implications of personal/group actions within the broader community; e.g., workplace	☐ analyzes the implications of personal/group actions within the global context ☐ states and defends a personal code of ethics as required

★**Developmental Framework**			
• *Simple task* • *Structured environment* • *Directed learning*	• *Task with limited variables* • *Less structured environment* • *Limited direction*	• *Task with multiple variables* • *Flexible environment* • *Self-directed learning, seeking assistance as required*	• *Complex task* • *Open environment* • *Self-directed/self-motivated*

GENERIC RATING SCALE

SCALE	RUBRIC STATEMENT (included in assessment tool/statements in *italics* are optional) *The student*:	IS TASK/ PROJECT COMPLETED?	PROBLEM SOLVING: STUDENT INITIATIVE VS TEACHER DIRECTION/ SUPPORT	USE OF TOOLS, MATERIALS, PROCESSES	*STANDARDS OF QUALITY/ PRODUCTIVITY*	*TEAMWORK LEADERSHIP*	*SERVICE CLIENT/ CUSTOMER*
4	exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals. Analyzes and provides effective client/customer services beyond expectations.*	Exceeds defined outcomes.	Plans and solves problems effectively and creatively in a self-directed manner.	Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.	*Quality, particularly details and finishes, and productivity are consistent and exceed standards.*	*Leads others to contribute team goals.*	*Analyzes and provides effective client/customer services beyond expectations.*
3	meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort. Analyzes and provides effective client/customer services.*	Meets defined outcomes.	Plans and solves problems in a self-directed manner.	Tools, materials and/or processes are selected and used efficiently and effectively.	*Quality and productivity are consistent.*	*Works cooperatively and contributes ideas and suggestions that enhance team effort.*	*Analyzes and provides effective client/customer services.*
2	meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals. Identifies and provides customer/client services.*	Meets defined outcomes.	Plans and solves problems with limited assistance.	Tools, materials and/or processes are selected and used appropriately.	*Quality and productivity are reasonably consistent.*	*Works cooperatively to achieve team goals.*	*Identifies and provides customer/client services.*
1	meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively. Provides a limited range of customer/client services.*	Meets defined outcomes.	Follows a guided plan of action.	A limited range of tools, materials and/or processes are used appropriately.	*Quality and productivity are reasonably consistent.*	*Works cooperatively.*	*Provides a limited range of customer/client services.*
0	has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.	Has not completed defined outcomes.		Tools, materials and/or processes are used inappropriately.			

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning • accurately describes an issue on which people disagree • poses an important question regarding the issue • accesses basic in-school/community information sources regarding the issue • uses one or more information-gathering techniques	**Preparation and Planning** • accurately describes an issue on which people disagree, explaining areas of disagreement • poses one or more thoughtful questions regarding the issue • accesses a range of relevant in-school/community resources • uses a range of information-gathering techniques	**Preparation and Planning** • accurately describes an issue on which people disagree, explaining specific causes of disagreement • poses thoughtful questions regarding the issue • accesses a range of relevant information sources and recognize when additional information is required • demonstrates resourcefulness in collecting data
Analyzing Perspectives • clarifies different points of view regarding the issue; *e.g., social, economic, environmental* • states a position on the issue and logical reasons for adopting that position • states an opposing position on the issue and logical reasons for adopting that position • identifies sources of conflict among different positions • distinguishes between fact and fiction/opinion/theory	**Analyzing Perspectives** • categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related* • states a position on the issue and logical reasons for adopting that position • state two or more opposing positions on the issue and logical reasons for adopting each position • describes interrelationships among different perspectives/points of view • determines accuracy/currency/reliability of information and ideas	**Analyzing Perspectives** • categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related, scientific, political* • states a position on the issue and insightful reasons for adopting that position • states three or more opposing positions on the issue and thoughtful reasons for adopting each position • analyzes interrelationships among different perspectives/points of view • recognizes underlying bias/assumptions/values in information and ideas
Collaboration and Teamwork • shares work appropriately among group members • respect the views of others	**Collaboration and Teamwork** • shares work appropriately among group members • respects and considers the views of others • negotiates solutions to problems	**Collaboration and Teamwork** • shares work appropriately among group members • respects and considers the views of others • negotiates with sensitivity solutions to problems
Evaluating Choices/Making Decisions • identifies useful alternatives regarding the issue • establishes criteria for assessing each alternative; *e.g., social, economic, environmental* • selects an appropriate alternative based on established criteria • reflects on strengths/weaknesses of decisions by considering consequences • communicates information in a logical sequence to justify choices/decisions made	**Evaluating Choices/Making Decisions** • identifies important and appropriate alternatives regarding the issue • establishes knowledge- and value-based criteria for assessing each alternative; *e.g., social, economic, environmental* • selects an appropriate alternative by showing differences among choices • assesses strengths/weaknesses of decisions by considering consequences • communicates ideas in a logical sequence with supporting detail to justify choices/decisions made	**Evaluating Choices/Making Decisions** • describes in detail important and appropriate alternatives regarding the issue • establishes knowledge- and value-based criteria for assessing each alternative; *e.g., social, economic, environmental* • selects an appropriate and useful alternative by showing differences among choices • assesses strengths/weaknesses of decisions by considering consequences and implications • communicate thoughts/feelings/ideas clearly to justify choices/decisions made

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Management • prepares self for task • organizes and works in an orderly manner • carries out instructions accurately • uses time effectively	**Management** • prepares self for task • organizes and works in an orderly manner • interprets and carries out instructions accurately • plans and uses time effectively • adheres to routine procedures	**Management** • prepares self for task • organizes and works in an orderly manner • interprets and carries out instructions accurately • plans and uses time effectively in a logical sequence • displays leadership in adhering to routine procedures • attempts to solve problems prior to requesting help
Teamwork • cooperates with group members • shares work appropriately among group members	**Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates solutions to problems	**Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates with sensitivity solutions to problems • displays effective communication skills
Use of Equipment and Materials • selects and uses appropriate equipment/materials • follows safe procedures/techniques • weighs and measures accurately • returns clean equipment/materials to storage areas	**Use of Equipment and Materials** • selects and uses appropriate equipment/materials • models safe procedures/techniques • weighs and measures accurately • practises proper sanitation procedures • minimizes waste of materials • advises of potential hazards and necessary repairs	**Use of Equipment and Materials** • selects and uses equipment/materials independently • demonstrates concern for safe procedures/techniques • weighs and measures accurately and efficiently • practises proper sanitation procedures • minimizes waste of materials • anticipates potential hazards and emergency response
Investigative Techniques • gathers and applies information from at least one source • makes predictions that can be tested • sets up and conducts experiments to test a prediction • distinguishes between manipulated/responding variables • obtains results that can be used to determine if some aspect of the prediction is accurate • summarizes important experimental outcomes	**Investigative Techniques** • gathers and applies information from a variety of sources • makes predictions that can be tested • plans, sets up and conducts experiments to test a prediction • identifies and explains manipulated/responding variables • obtains accurate results that confirm/reject the prediction • summarizes and applies experimental outcomes	**Investigative Techniques** • uses relevant information to explain observations • makes predictions that can be tested • plans, sets up and conducts experiments to test a prediction • analyzes relationships among manipulated/responding variables • obtains accurate results that confirm/reject prediction and answer related questions • summarizes, applies and evaluates experimental outcomes

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning	**Preparation and Planning**	**Preparation and Planning**
• accurately describes an issue on which people disagree	• accurately describes an issue on which people disagree, explaining areas of disagreement	• accurately describes an issue on which people disagree, explaining specific causes of disagreement
• poses an important question regarding the issue	• poses one or more thoughtful questions regarding the issue	• poses thoughtful questions regarding the issue
• accesses basic in-school/community information sources regarding the issue	• accesses a range of relevant in-school/community resources	• accesses a range of relevant information sources and recognizes when additional information is required
• uses one or more information-gathering techniques	• uses a range of information-gathering techniques	• demonstrates resourcefulness in collecting data
Analyzing Perspectives	**Analyzing Perspectives**	**Analyzing Perspectives**
• states a position on the issue and logical reasons for adopting that position	• states a position on the issue and logical reasons for adopting that position	• states a position on the issue and insightful reasons for adopting that position
• explains why the issue is important by presenting examples of possible consequences	• explains why the issue is important by presenting examples of possible consequences	• explains why the issue is important by presenting examples of possible consequences and implications
• clarifies different points of view regarding the issue; *e.g., social, economic, environmental*	• categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related*	• categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related, scientific, political*
• distinguishes between fact and fiction/opinion/theory	• determines accuracy/currency/reliability of information and ideas	• recognizes underlying bias/assumptions/values in information and ideas
Collaboration and Teamwork	**Collaboration and Teamwork**	**Collaboration and Teamwork**
• works with a range of peer members	• works with a range of peer members	• works with a wide range of peer members
• shares information/opinions/suggestions through group discussion	• shares information/opinions/suggestions, maintaining a balance between speaking and listening	• shares information/opinions/suggestions, maintaining a balance between speaking and listening
• listens to and respects the views of others	• listens to and respects the views of others, requesting clarification as necessary from other group members	• listens to and respects the views of others, requesting clarification as necessary from other group members
Negotiating and Debating	**Negotiating and Debating**	**Negotiating and Debating**
• presents a convincing argument in logical sequence supporting a position adopted on the issue	• presents a convincing argument in logical sequence supporting a position adopted, conveying points in order of importance	• presents a convincing argument in logical sequence supporting a position adopted, conveying points in order of importance and backing each with sound evidence
• provides a relevant response to opposing arguments	• provides a relevant and convincing response to opposing arguments	• provides a relevant and convincing rebuttal to opposing arguments
• speak clearly so the argument can be understood	• speaks clearly without hesitation so the argument can be understood	• speaks clearly without hesitation so the argument can be understood by all listeners
• establishes a shared understanding of key alternatives and consequences relevant to the issue	• negotiates a shared agreement on preferred alternatives relevant to the issue	• negotiates a shared agreement on preferred alternatives by resolving divergent points of view

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning • sets goals and follows instructions accurately • responds to directed questions and follows necessary steps to find answers • accesses basic in-school/community information sources • interprets and organizes information into a logical sequence • records information accurately, using correct technical terms • uses time effectively	**Preparation and Planning** • sets goals and describes steps to achieve them • uses personal initiative to formulate questions and find answers • accesses a range of relevant in-school/community resources • interprets, organizes and combines information into a logical sequence • records information accurately with appropriate supporting detail and using correct technical terms • plans and uses time effectively • gathers and responds to feedback regarding approach to task and project status	**Preparation and Planning** • sets goals and describes steps to achieve them • uses personal initiative to formulate questions and find answers • accesses a range of relevant information sources and recognizes when additional information is required • interprets, organizes and combines information in creative and thoughtful ways • records information accurately, using appropriate technical terms and supporting detail • plans and uses time effectively, prioritizing tasks on a consistent basis • assesses and refines approach to task and project status based on feedback and reflection
Presentation • demonstrates effective use of at least one medium of communication: *e.g.,* <u>*Written*</u>*:* *spelling, punctuation, grammar, basic format* <u>*Oral*</u>*:* *voice projection, body language* <u>*Audio-visual*</u>*:* *techniques, tools*	**Presentation** • demonstrates effective use of at least two communication media: *e.g.,* <u>*Written*</u>*:* *spelling, punctuation, grammar, format (formal/informal)* <u>*Oral*</u>*:* *voice projection, body language, appearance* <u>*Audio-visual*</u>*:* *techniques, tools, clarity*	**Presentation** • demonstrates effective use of a variety of communication media: *e.g.,* <u>*Written*</u>*:* *spelling, punctuation, grammar, format (formal/informal, technical/literary)* <u>*Oral*</u>*:* *voice projection, body language, appearance, enthusiasm, evidence of prior practice* <u>*Audio-visual*</u>*:* *techniques, tools, clarity, speed and pacing*
• uses correct grammatical convention and technical terms through proofreading/editing • provides an introduction that describes the purpose of the project • communicates information in a logical sequence • states a conclusion based on a summary of facts • provides a reference list of three or more basic information sources	• maintains acceptable grammatical and technical standards through proofreading and editing • provides an introduction that describes the purpose and scope of the project • communicates ideas into a logical sequence with sufficient supporting detail • states a conclusion by synthesizing the information gathered • provides a reference list that includes five or more relevant information sources	• maintains acceptable grammatical and technical standards through proofreading and editing • provides an introduction that describes the purpose and scope of the project • communicates thoughts/feelings/ideas clearly to justify or challenge a position • states a conclusion by analyzing and synthesizing the information gathered • gives evidence of adequate research through a reference list including seven or more relevant information sources

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning • sets goals and follows instructions accurately • adheres to established timelines • responds to directed questions and follows necessary steps to find answers • uses time effectively	**Preparation and Planning** • sets goals and establishes steps to achieve them • creates and adheres to useful timelines • uses personal initiative to formulate questions and find answers • plans and uses time effectively	**Preparation and Planning** • sets clear goals and establishes steps to achieve them • creates and adheres to detailed timelines • uses personal initiative to formulate questions and find answers • plans and uses time effectively, prioritizing tasks on a consistent basis
Information Gathering and Processing • accesses basic in-school/community information sources • uses one or more information-gathering techniques • interprets and organizes information in a logical sequence • records information accurately, using correct technical terms • distinguishes between fact and fiction/opinion/theory • responds to feedback when current approach is not working	**Information Gathering and Processing** • accesses a range of relevant in-school/community resources • uses a range of information-gathering techniques • interprets, organizes and combines information into a logical sequence • records information accurately with appropriate supporting detail and using correct technical terms • determines accuracy/currency/reliability of information sources • gathers and responds to feedback regarding approach to the task	**Information Gathering and Processing** • accesses a range of relevant information sources and recognizes when additional information is required • demonstrates resourcefulness in collecting data • interprets, organizes and combines information in creative and thoughtful ways • records information accurately with appropriate supporting detail and using correct technical terms • recognizes underlying bias/assumptions/values in information sources • assesses and refines approach to the task and project status based on feedback and reflection
Collaboration and Teamwork • cooperates with group members • shares work appropriately among group members	**Collaboration and Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates solutions to problems	**Collaboration and Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates with sensitivity solutions to problems • displays effective communication and leadership skills
Information Sharing • demonstrates effective use of one or more communication media; *e.g., written, oral, audio-visual* • communicates information in a logical sequence • uses correct grammatical convention and technical terms • cites three or more basic information sources	**Information Sharing** • demonstrates effective use of two or more communication media; *e.g., written, oral, audio-visual* • communicates ideas in a logical sequence with sufficient supporting detail • maintains acceptable grammatical and technical standards • cites five or more relevant information sources	**Information Sharing** • demonstrates effective use of a variety of communication media; *e.g., written, oral, audio-visual* • communicates thoughts/feelings/ideas clearly to justify or challenge a position • maintains acceptable grammatical and technical standards • gives evidence of adequate information gathering by citing seven or more relevant information sources

Standard: Three career profiles, all sections completed for each profile

Area of Career Exploration: ______________________ **for Module** ______________

Career Profile 1	Career Profile 2	Career Profile 3
JOB TITLE:	**JOB TITLE:**	**JOB TITLE:**
Description (tasks, working conditions)	Description (tasks, working conditions)	Description (tasks, working conditions)
Education Qualifications	Education qualifications	Education qualifications
Employment Opportunities	Employment Opportunities	Employment Opportunities
Advancement Potential	Advancement potential	Advancement potential
Salary Range and Benefits	Salary range and benefits	Salary range and benefits
Would you enjoy this type of work? Why? Why not?	Would you enjoy this type of work? Why? Why not?	Would you enjoy this type of work? Why? Why not?
Reference used (book, interview, etc.)	Reference used (book, interview, etc.)	Reference used (book, interview, etc.)

STUDENT: **TRAINING SITE:** **WORK ORDER/TASK:**

Observed Rating	Standard Intro.	Inter.	Adv.	CRITERIA *The Student*
______	1	2	3	**PART 1 Customer Need** ☐ greets customer in appropriate manner ☐ is friendly/helpful while receiving order ☐ asks leading questions to prompt customer response. ☐ ______
______	1	2	3	**Writing Work Order** ☐ provides proper opening and closing ☐ enters required details ☐ uses appropriate service data (serial #, etc.) ☐ is legible ☐ ______
______	1	2	3	**PART 2 Performs Service** ☐ responds to customer need ☐ sees other potential problems ☐ manages time ☐ shows eagerness, enthusiasm for working on customer tasks ☐ shows commitment to quality service ☐ demonstrate ethics ☐ ______
______	1	2	3	**Work Collaboratively** ☐ is able to get along with co-workers ☐ takes responsibility for balanced work load ☐ contributes to problem solving and decision making ☐ ______
______	1	2	3	**Quality of Service** ☐ service meets work order request ☐ service exhibits completeness in adjustments, replacement of components and operation ☐ uses supplies effectively, tools used correctly ☐ cleanliness / general appearance restored ☐ report portrays service performed
______	1	2	3	**PART 3 Maintenance Schedule** ☐ includes unit descriptive information ☐ includes service variables – function, frequency of use, operating conditions, service cost versus replacement ☐ shows comprehensive schedule ☐ ______
______	1	2	3	**PART 4 Problem Solving** ☐ understands the problem ☐ selects appropriate resources (including tools, equipment, supplies) ☐ is able to test/examine or narrow the problem ☐ is able to provide one or more solutions to the problem ☐ is able to solve the problem ☐ is able to refine the problem-solving process

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals. Analyzes and provides effective client/customer services beyond expectations.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort. Analyzes and provides effective client/customer services.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals. Identifies and provides customer/client services.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively. Provides a limited range of customer/client services*

0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

REFLECTIONS/COMMENTS:

STANDARD	Students working **at standard** must demonstrate the requirements outlined in the checklist below. The columns to the left of the checklists indicate the minimum rating for *at standard* performance for introductory, intermediate and advanced level modules. The rating scale on the right defines the levels of competencies and should be applied when assessing student performance.

Observed Rating	Standard Intro.	Inter.	Adv.	TASK PERFORMANCE CRITERIA *The student:*
_____	1	2	3	PART 1 **Fundamentals Electricity/Electronics/Optics/Mechanics** ☐ states the function of system/circuit ☐ explains the operation of system/circuit ☐ explains electrical/electronics concepts involved
_____	1	2	3	PART 2 **Planning and Preparation** ☐ uses schematics, manuals, resources ☐ creates/uses block diagram(s), flow chart(s) ☐ identifies and locates components ☐ creates/uses a PCB circuit layout
_____	1	2	3	**Analyses (Systems, Sub Systems, Components)** ☐ identifies system(s), sub system(s), component(s) ☐ states component value, characteristics ☐ identifies component placement ☐ applies computer simulation of circuit ☐ installs and configures software
_____	1	2	3	PART 3 **Constructing / Prototyping** ☐ constructs electrical/electronic prototype ☐ installs materials/components cabling for given application ☐ uses correct tools, equipment and procedures ☐ applies correct soldering/connecting techniques
_____	1	2	3	PART 4 **Evaluates / Testing** ☐ shows how system operates within given parameters ☐ analyzes basic electrical circuit ☐ uses correct voltage source uses multimeter (analog & digital) ☐ uses a voltmeter ☐ uses an ammeter ☐ uses an ohmmeter ☐ uses an oscilloscope ☐ able to interpret results
_____	1	2	3	PART 5 **Problem Solving** ☐ identify system/subsystem problem area. ☐ researches steps to solve problem ☐ follows flow chart ☐ able to correct problem ☐ performs routine maintenance

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals.* .

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort..*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.* .

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively.*

0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

REFLECTIONS/COMMENTS:

STANDARD	Students working **at standard** must demonstrate the requirements outlined in the checklist below. The columns to the left of the checklists indicate the minimum rating for *at standard* performance for introductory, intermediate and advanced level modules. The rating scale on the right defines the levels of competencies and should be applied when assessing student performance.

Observed Rating	Standard Intro.	Inter.	Adv.	TASK PERFORMANCE CRITERIA *The student*
____	1	2	3	PART 1 **Fundamentals AC/DC, Analog, Digital** ☐ applies electrical/electronic/digital principles to circuit analysis ☐ applies mathematical principles to circuit analysis ☐ analyzes basic electrical/electronic circuits ☐ research electrical/electronic circuits using variety of media ☐ creates/uses block diagrams, flow charts, truth tables
____	1	2	3	PART 2 **Design and Prototype** ☐ uses critical path method to plan, schedule, control and coordinate project activities ☐ designs electronic circuits ☐ designs pulse and digital devices ☐ creates electronic prototype ☐ designs filter circuits ☐ designs tuned and resonant circuits. ☐ design voltage regulator circuit
____	1	2	3	**Fabrication** ☐ completes project (see conditions and criteria) ☐ ______
____	1	2	3	PART 3 **Troubleshooting/Analyze** ☐ assesses typical analog circuit ☐ assesses amplifier circuits ☐ assesses oscillator circuits ☐ assesses AC networks ☐ assesses typical digital circuit ☐ assesses digital signal processors. ☐ assesses rectifier circuit
____	1	2	3	**Testing/Measuring** ☐ selects and uses meters ☐ selects and uses oscilloscopes ☐ selects and uses signal generators ☐ selects and uses power supplies ☐ selects and uses analog/digital signal analyzers ☐ measures logic sequences with captive and storage analyzers
____	1	2	3	**Computers** ☐ uses simulation software package ☐ uses to create, test and evaluate circuit(s) ☐ analyzes equipment ☐ uses to manage information

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.*

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1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively.*

0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

REFLECTIONS/COMMENTS:

STANDARD	Students working **at standard** must demonstrate the requirements outlined in the checklist below. The columns to the left of the checklists indicate the minimum rating for *at standard* performance for introductory, intermediate and advanced level modules. The rating scale on the right defines the levels of competencies and should be applied when assessing student performance.

Observed Rating	Standard Intro.	Inter.	Adv.	TASK PERFORMANCE CRITERIA *The student*	
____	1	2	3	**PART 1 Fundamentals AC/DC, Digital, Semi-conductors** ☐ applies electronic principles to circuit analysis ☐ applies boolean algebra principles to circuit analysis ☐ analyzes basic digital gates and combinational and sequential circuiting	☐ creates/uses block diagrams, flow charts, truth tables, ladder logic ☐ research electrical/electronic circuits using multimedia
____	1	2	3	**PART 2 Design and Prototype** ☐ uses critical path method to plan, schedule, control and coordinate project activities ☐ designs electronic circuits	☐ designs pulse and digital devices ☐ creates electronic prototype ☐ design PLC address codes
____	1	2	3	**Fabrication** ☐ completes project (see criteria and conditions) ☐ creates PCB board	☐ installs semi-conductor components ☐ connects input and output devices
____	1	2	3	**PART 3 Troubleshooting/ Analyze** ☐ assesses gates ☐ assesses sequential circuits ☐ assesses combinational logic/ladder logic	☐ assesses analog devices ☐ assesses input/output devices
____	1	2	3	**PART 4 Testing/Measuring** ☐ selects and uses logic probes ☐ selects and uses oscilloscopes ☐ selects and uses signal generators	☐ selects and uses power supplies
____	1	2	3	**Computers** ☐ uses simulation software package ☐ uses to create, test and evaluate circuit(s) ☐ creates programming logic code	☐ creates PC board layout ☐ analyzes equipment ☐ uses to manage information

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes and productivity are consistent and exceed standards. Leads others to contribute team goals.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively.*

0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

REFLECTIONS/COMMENTS:

PROJECT ASSESSMENT FORM	**ELTPAF**

STANDARD	Students working at standard must demonstrate the requirements outlined in the checklist below to the standard as indicated in module assessment criteria and conditions. The minimum rating for *at standard* performance for introductory is 1, intermediate 2, and advanced level modules 3. Refer to generic rating scale that further defines competencies at the various levels.				
Scale	**Teacher Direction/Support/ Student Initiative**	**Problem Solving**	**Use of Tools/Materials/ Processes**	**Standards of Quality/ Productivity**	**SUMMARY STATEMENTS** ***the student has:***
4	Student outlines project with no teacher guidance.	Student prepares plan of action, makes creative adjustments to ensure final outcome and expected outcome.	Student selects most appropriate tools, most efficient process.	No errors or deficiencies are noted. Standards of quality and productivity exceed defined outcomes.	***REFLECTIONS/ COMMENTS:***
3 minimum at advanced level	Student outlines project/plan action with minimal teacher guidance.	Student prepares and follows detailed plan of action and expected outcome.	Student selects appropriate tools and processes.	No errors or deficiencies are noted. Standards of quality and productivity are consistent.	
2 minimum at intermediate level	Teacher outlines project and expected outcomes and student has input to plan of action.	Student follows plan of action with minimal assistance.	Appropriate uses/follows as prescribed.	Minor errors/deficiencies are evident. Standards of quality and productivity occasionally inconsistent.	
1 minimum at introductory level	Teacher outlines project and detailed plan of action.	Student follows plan of action with assistance.	Uses/follows as prescribed with occasional errors.	Some errors/deficiencies are evident. Standards of quality and productivity often inconsistent.	
Incomplete					

ASSESSMENT CHECKLIST: Laboratory Procedures and Safety Practices — ELTPSP

STANDARD	Students working **at standard** must demonstrate the technique requirements outlined in the checklists below. The columns to the left of the checklists indicate the minimum rating for *at standard* performance for introductory, intermediate and advanced level modules. The rating scale on the right-hand defines the levels of competencies and should be applied when assessing student performance.

Observed Rating	Minimum Standard (Intro Level)	Minimum Standard (Inter Level)	Minimum Standard (Adv. Level)	CRITERIA
—	1	2	3	***The student:*** ***Part I*** **Resource:** ☐ prepares self for task ☐ organizes and works in an orderly manner ☐ identifies appropriate tools and resources ☐ ________________
—	1	2	3	**Lab Routines:** ☐ follows established routines ☐ recognizes and avoids unsafe acts and conditions ☐ demonstrates responsibility for housekeeping ☐ is aware of first aid and emergency practices ☐ uses time effectively ☐ ________________
—	1	2	3	**Tools and Equipment:** ☐ identifies appropriate tools and equipment ☐ uses tools and equipment in a safe manner ☐ uses personal protective equipment ☐ stores tools, material and equipment as instructed ☐ ________________

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes and productivity are consistent and exceed standards. Leads others to contribute team goals.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively.*

0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

REFLECTIONS/COMMENTS:

	Projects		
	Part 1	Part 2	Part 3
TASK PERFORMANCE CRITERIA	Simple Project	Electro-Magnetic Project	Cable and Cord Ends
The student:	Observed Rating	Observed Rating	Observed Rating
Planning: ☐ prepares self for task ☐ organizes and works in an orderly manner ☐ uses time effectively ☐ creates a system layout			
Construction: ☐ constructs circuit(s) as planned ☐ produces a circuit meeting standards of quality in: – solder connections – wiring accuracy (connections and coding) – neatness ☐ produces a product that performs all the required functions ☐ describes function and operation of the system			
Testing ☐ tests for continuity ☐ tests for voltage at appropriate locations			

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 Has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

REFLECTIONS/COMMENTS:

PROJECT ASSESSMENT: Electrical Energy Conversion and Distribution — ELT1030–1

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers or perform tasks
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Presenting/Reporting
- ☐ identifies and describes methods of converting nonrenewable and renewable sources of energy into electricity
- ☐ determines the cost efficiency, practicality and environmental impact of producing electricity from various sources of energy

Prototyping
- ☐ constructs an electrical distribution system which has a source, load, connectors and control. Electrical circuits must include series and parallel connections
- ☐ demonstrates how mechanical, chemical, light, heat and pressure can be converted to electrical energy

Work Skills
- ☐ transfers information to develop a prototype
- ☐ safely connects components as required
- ☐ uses tools and equipment in a safe manner
- ☐ uses proper personal protective equipment
- ☐ demonstrates responsibility for housekeeping
- ☐ analyzes the system and takes appropriate measures to correct/improve

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Prototyping	4	3	2	1	N/A
Work Skills	4	3	2	1	N/A

PRESENTATIONS/REPORTS: Power Supplies — ELT1050–1

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Content
- ☐ identifies and describes AC/DC power supplies including:
  - – ways in which power supplies are rated
  - – differences in voltage, current and power ratings
  - – rectifiers configurations

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  - *e.g., Written: spelling, punctuation, grammar, basic format*
  - *Oral: voice projection, body language*
  - *Audio-visual: techniques, tools*
- ☐ uses correct grammatical conventions and technical terms through proofreading/editing
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical sequence
- ☐ states a conclusion based on a summary of facts
- ☐ provides a reference list of basic information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Content
- ☐ identifies and describes binary numbering system and logic gates
  - identifies and converts 2, 8 and 16 numbering systems
  - identifies basic logic gates symbols
  - states function of basic logic gates
  - writes truth table for a logic gate circuit
- ☐ identifies major IC families and describes their respective functions
- ☐ constructs the required logic circuit and describes its function

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, basic format
  Oral: voice projection, body language
  Audio-visual: techniques, tools
- ☐ uses correct grammatical conventions and technical terms through proofreading/editing
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical sequence
- ☐ states a conclusion based on a summary of facts
- ☐ provides a reference list of basic information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Content
- ☐ lists and describes four different control systems used in home or commercial settings such as, temperature control, liquid level indictor, movement indicator
- ☐ describes how basic process controls, including open and closed loops, function

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>Written</u>: spelling, punctuation, grammar, basic format
  <u>Oral:</u> voice projection, body language
  <u>Audio-visual:</u> techniques, tools
- ☐ uses correct grammatical conventions and technical terms through proofreading/editing
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical sequence
- ☐ states a conclusion based on a summary of facts
- ☐ provides a reference list of basic information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting / Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Content
- ☐ explains and distinguishes the difference between:
  - wattage
  - peak value
  - sine waves
  - distortion
  - impedance matching

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>Written</u>: spelling, punctuation, grammar, basic format
  <u>Oral:</u> voice projection, body language
  <u>Audio-visual:</u> techniques, tools
- ☐ uses correct grammatical conventions and technical terms through proofreading/editing
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical sequence
- ☐ states a conclusion based on a summary of facts
- ☐ provides a reference list of basic information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Content
- ☐ explains operating principles of a CCTV and a CATV video system
- ☐ describes and compares video formats for Beta, VHS and 8 mm systems
- ☐ explains the operating principles of a given analog modulated video system

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., __Written__: spelling, punctuation, grammar, basic format
  __Oral:__ voice projection, body language
  __Audio-visual:__ techniques, tools
- ☐ uses correct grammatical conventions and technical terms through proofreading/editing
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical sequence
- ☐ states a conclusion based on a summary of facts
- ☐ provides a reference list of basic information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

PRESENTATIONS/REPORTS: Security Systems — ELT1110–1

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Content
- ☐ identifies and compares security systems used to secure:
  - people
  - property
  - information
- ☐ describes and compares the following security sensors:
  - contact closure
  - motion sensor
  - thermal sensor
  - moisture sensor
  - light sensor

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, basic format
  Oral: voice projection, body language
  Audio-visual: techniques, tools
- ☐ uses correct grammatical conventions and technical terms through proofreading/editing
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical sequence
- ☐ states a conclusion based on a summary of facts
- ☐ provides a reference list of basic information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting / Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and follows instructions
- ☐ responds to directed questions and follows necessary steps to obtain answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information into a logical sequence
- ☐ records information accurately using proper technical terms
- ☐ uses time effectively

Content
- ☐ describes the evolution and applications of robotics systems
- ☐ identifies and classifies robotic systems and subsystems

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, basic format
  Oral: voice projection, body language
  Audio-visual: techniques, tools
- ☐ uses correct grammatical conventions and technical terms through proofreading/editing
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical sequence
- ☐ states a conclusion based on a summary of facts
- ☐ provides a reference list of basic information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

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2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

PRESENTATIONS/REPORTS: Circuit Boards

TASK CHECKLIST

The student:

Preparation and Planning

- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content

- ☐ identifies appropriate construction methods to fabricate a circuit board
- ☐ uses a PC board to assemble a project using proper fabrication techniques

Presenting/Reporting

- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, format (formal/informal)
  Oral: voice projection, body language appearance
  Audio-visual: techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

PRESENTATIONS/REPORTS: Computer Systems — ELT2070–1

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content
- ☐ disassembles/assembles a working computer and performs basic troubleshooting techniques
- ☐ identifies and explains computer system components
- ☐ describes the internal architecture of a computer system

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, format (formal/informal)
  Oral: voice projection, body language appearance
  Audio-visual: techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content
- ☐ identifies discrete components used in process control
- ☐ constructs a process control device using analog and sensor components

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>Written</u>: spelling, punctuation, grammar, format (formal/informal)
  <u>Oral:</u> voice projection, body language appearance
  <u>Audio-visual:</u> techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

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TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning

- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content

- ☐ identifies and explains the characteristics of analog communications systems including:
  - telephones
  - audio amplifiers
  - intercom systems
  - light and sound boards
  - automotive sensors

Presenting/Reporting

- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, format (formal/informal)
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  Audio-visual: techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
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- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

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TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning

- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content

- ☐ constructs and tests electromagnetic communication systems such as:
  - AM, FM radio
  - short-wave radio
  - satellite communication
  - cellular telephone
  - CATV
  - two-way radio

Content (continued)

- ☐ explain wireless communication in terms of:
  - amplitude modulation
  - frequency modulation
  - frequency spectrum
  - sidebands

Presenting/Reporting

- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, format (formal/informal)
  Oral: voice projection, body language appearance
  Audio-visual: techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

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TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content
- ☐ identifies and describes elements of a security system such as:
  - control panel
  - detection device
  - notification device
- ☐ identifies the appropriate switches, detectors beams and alarms used in a security system

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>Written</u>: spelling, punctuation, grammar, format (formal/informal)
  <u>Oral:</u> voice projection, body language appearance
  <u>Audio-visual:</u> techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

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TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

PRESENTATIONS/REPORTS: Lasers and Fibre Optics — ELT2120–1

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content
- ☐ list and describes the use of six types of lasers, such as:
  - helium
  - neon
  - krypton
  - cadmium
  - argon
  - carbon dioxide

Content (continued)
- ☐ identifies and describes the hazards associated with I, II, III and IV classes of lasers
- ☐ explains the principles of laser fibre optics, infrared and hologram light wave technology

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>*Written*</u>*: spelling, punctuation, grammar, format (formal/informal)*
  <u>*Oral:*</u> *voice projection, body language appearance*
  <u>*Audio-visual:*</u> *techniques, tools, clarity*
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning

- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content

- ☐ identifies sensor control systems that use:
  - photoelectric
  - sound
  - tactile
  - thermal control device
- ☐ explains how sensor control systems are used to control a drive circuit
- ☐ describes the operation of sensory control devices

Presenting/Reporting

- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>Written</u>: spelling, punctuation, grammar, format (formal/informal)
  <u>Oral:</u> voice projection, body language appearance
  <u>Audio-visual:</u> techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

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TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant in-school/community resources
- ☐ interprets, organizes and combines information into a logical sequence
- ☐ records information accurately with appropriate supporting detail and uses proper technical terms
- ☐ plans and uses time effectively
- ☐ gathers and responds to feedback regarding approach to task and project status

Content
- ☐ explains basic input and output hardware and programming for programmable logic control systems such as:
  - timing relay control of a lamp or solenoid
  - two-light source relay
  - single-location panic stop
  - one- and two-location start/stop of a single-phase motor
  - single-location forward/reverse/stop of a single-phase motor
  - single-location start/stop/jog of a single-phase motor

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>Written</u>: spelling, punctuation, grammar, format (formal/informal)
  <u>Oral:</u> voice projection, body language appearance
  <u>Audio-visual:</u> techniques, tools, clarity
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates ideas into a logical sequence with sufficient supporting detail
- ☐ states a conclusion by synthesizing the information gathered
- ☐ provides a reference list of relevant information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning

- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant information sources and recognizes when additional information is required
- ☐ interprets, organizes and combines information in thoughtful ways
- ☐ records information accurately using appropriate technical terms and supporting detail
- ☐ plans and uses time effectively, prioritizing tasks on a consistent basis
- ☐ accessing and refines approach to task and project based on feedback and reflection

Content

- ☐ lists and describes three methods of preparing a circuit board using:
  - holographic
  - silk screen
  - toner transfer
  - techniques

Content (continued)

- ☐ identifies hazards associated with the use of photo, cleaning and etching chemicals

Presenting/Reporting

- ☐ demonstrates effective use of one or more communication media:
  e.g., <u>Written</u>: spelling, punctuation, grammar, format (formal/informal, technical/literary)
  <u>Oral:</u> voice projection, body language appearance, enthusiasm, evidence of prior practice
  <u>Audio-visual:</u> techniques, tools, clarity, speed and pacing
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates thoughts/feelings/ideas clearly to justify or challenge a position
- ☐ states a conclusion by analyzing and synthesizing the information gathered
- ☐ gives evidence of adequate research through a reference list of information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

PRESENTATIONS/REPORTS: Electronic Service and Repair — ELT3020–1

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant information sources and recognizes when additional information is required
- ☐ interprets, organizes and combines information in thoughtful ways
- ☐ records information accurately using appropriate technical terms and supporting detail
- ☐ plans and uses time effectively, prioritizing tasks on a consistent basis
- ☐ accessing and refines approach to task and project based on feedback and reflection

Content
- ☐ uses block diagrams to show the function and stages of operation of electronic devices such as:
  - TV
  - VCR
  - camcorder
  - computer
  - microwave oven

Content (continued)
- ☐ lists and describes safe testing techniques to identify system faults

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, format (formal/informal, technical/literary)
  Oral: voice projection, body language appearance, enthusiasm, evidence of prior practice
  Audio-visual: techniques, tools, clarity, speed and pacing
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates thoughts/feelings/ideas clearly to justify or challenge a position
- ☐ states a conclusion by analyzing and synthesizing the information gathered
- ☐ gives evidence of adequate research through a reference list of information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Analyzes and provides effective client/customer services beyond expectations.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Analyzes and provides effective client/customer services.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Identifies and provides customer/client services.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality of work is reasonably consistent. Provides a limited range of customer/client services.*

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant information sources and recognizes when additional information is required
- ☐ interprets, organizes and combines information in thoughtful ways
- ☐ records information accurately using appropriate technical terms and supporting detail
- ☐ plans and uses time effectively, prioritizing tasks on a consistent basis
- ☐ accessing and refines approach to task and project based on feedback and reflection

Content
- ☐ explains the principles of operation of electrical components used as safety devices such as:
  - plug and cartridge fuse
  - renewable and time delay fuse
  - bi-metal and time delay circuit breaker
  - magnetic and thermal overload relays
  - GFI circuit protectors

Content (continued)
- ☐ identifies the operating characteristics of single-phase transformers
- ☐ explains the operation of three-phase low voltage alternators

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, format (formal/informal, technical/literary)
  Oral: voice projection, body language appearance, enthusiasm, evidence of prior practice
  Audio-visual: techniques, tools, clarity, speed and pacing
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates thoughts/feelings/ideas clearly to justify or challenge a position
- ☐ states a conclusion by analyzing and synthesizing the information gathered
- ☐ gives evidence of adequate research through a reference list of information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning
- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant information sources and recognizes when additional information is required
- ☐ interprets, organizes and combines information in thoughtful ways
- ☐ records information accurately using appropriate technical terms and supporting detail
- ☐ plans and uses time effectively, prioritizing tasks on a consistent basis
- ☐ accessing and refines approach to task and project based on feedback and reflection

Content
- ☐ compares the internal architecture of various families of microprocessors
- ☐ describes how to program a microprocessor using an instruction set
- ☐ describes input/output operations in microprocessors

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media:
  e.g., Written: spelling, punctuation, grammar, format (formal/informal, technical/literary)
  Oral: voice projection, body language appearance, enthusiasm, evidence of prior practice
  Audio-visual: techniques, tools, clarity, speed and pacing
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates thoughts/feelings/ideas clearly to justify or challenge a position
- ☐ states a conclusion by analyzing and synthesizing the information gathered
- ☐ gives evidence of adequate research through a reference list of information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

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1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

PRESENTATIONS/REPORTS: Microprocessor Interface — ELT3090–1

TASK CHECKLIST

The student:

Preparation and Planning

- ☐ sets goals and describes steps to achieve them
- ☐ uses personal initiative to formulate questions and find answers
- ☐ accesses a range of relevant information sources and recognizes when additional information is required
- ☐ interprets, organizes and combines information in thoughtful ways
- ☐ records information accurately using appropriate technical terms and supporting detail
- ☐ plans and uses time effectively, prioritizing tasks on a consistent basis
- ☐ accessing and refines approach to task and project based on feedback and reflection

Content

- ☐ describes microprocessor interface output and input circuits
- ☐ explains the operation of a serial interface device
- ☐ explains how to interface a D/A and a A/D converter to a microprocessor

Content continued)

Presenting/Reporting

- ☐ demonstrates effective use of one or more communication media:
  - *e.g.,* Written: *spelling, punctuation, grammar, format (formal/informal, technical/literary)*
  - Oral: *voice projection, body language appearance, enthusiasm, evidence of prior practice*
  - Audio-visual: *techniques, tools, clarity, speed and pacing*
- ☐ maintains acceptable grammatical and technical standards through proofreading and editing
- ☐ provides an introduction that describes the purpose and scope of the project
- ☐ communicates thoughts/feelings/ideas clearly to justify or challenge a position
- ☐ states a conclusion by analyzing and synthesizing the information gathered
- ☐ gives evidence of adequate research through a reference list of information sources

REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

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TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

TASK CHECKLIST

The student:

Preparation and Planning

☐ sets goals and describes steps to achieve them
☐ uses personal initiative to formulate questions and find answers
☐ accesses a range of relevant information sources and recognizes when additional information is required
☐ interprets, organizes and combines information in thoughtful ways
☐ records information accurately using appropriate technical terms and supporting detail
☐ plans and uses time effectively, prioritizing tasks on a consistent basis
☐ accessing and refines approach to task and project based on feedback and reflection

Content

☐ explains the electromotive principles and operational characteristics of common AC and DC motors such as:
- shaded pole
- split phase
- capacitive start and run
- three-phase
- universal
- single-phase synchronous
- stepper
- servo
- permanent magnet

Presenting/Reporting

☐ demonstrates effective use of one or more communication media:
e.g., <u>*Written:*</u> *spelling, punctuation, grammar, format (formal/informal, technical/literary)*
<u>*Oral:*</u> *voice projection, body language appearance, enthusiasm, evidence of prior practice*
<u>*Audio-visual:*</u> *techniques, tools, clarity, speed and pacing*
☐ maintains acceptable grammatical and technical standards through proofreading and editing
☐ provides an introduction that describes the purpose and scope of the project
☐ communicates thoughts/feelings/ideas clearly to justify or challenge a position
☐ states a conclusion by analyzing and synthesizing the information gathered
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REFLECTIONS/COMMENTS:

Standard

Performance rating of 1 for each applicable task

Rating Scale

The student:

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TASKS	OBSERVED RATING				
Preparation and Planning	4	3	2	1	N/A
Content	4	3	2	1	N/A
Presenting/ Reporting	4	3	2	1	N/A

ELECTRO-TECHNOLOGIES

SECTION H: LINKAGES/TRANSITIONS

This section of the Guide has been designed to provide an overview of linkages and transitions of CTS modules with a number of organizations. The charts and information presented in this section will assist CTS students and teachers in understanding the potential application of CTS modules as students move into the workplace.

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CREDENTIALLING H.5

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- Electro-Technologies: Connections with Other CTS Strands H.8
- Electro-Technologies: Connections Across the Curriculum H.9
- Electro-Technologies: Junior High School Module Clusters H.10
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LINKAGES/TRANSITIONS

There are many opportunities for students in Electro-Technologies to build linkages among CTS strands and across other subject areas, including core and complementary programs. In addition to making linkages across the curriculum, making connections between what the students have already learned in other settings (e.g., home, community and workplace) can also be achieved through this strand.

LINKAGES

With Basic Competencies

The Electro-Technologies strand supports the development and integration of the basic competencies related to personal and resource management, problem solving, safe work practices and social interactions throughout the introductory, intermediate and advanced modules. It is important that students develop these competencies because success in the workplace often depends more on these skills than on many of the technical or academic skills they possess.

With Other CTS Strands

Electro-Technologies complements modules from a number of other strands.

The following chart represents possible linkages with other strands that may be of interest to Electro-Technologies students:

Strand	Module	Linkage
Career Transitions	Safety modules	used in conjunction with safety components in Electro-Technologies.
	Project modules	use when student wants to increase proficiency or enhance projects that are beyond module expectations.
Community Health	First Aid module	provides opportunities for first aid certification.
	Volunteer module	used where student is prepared to volunteer time using Electro-Technologies competencies.
Enterprise and Innovation	Business ventures	identifying opportunities for business ventures.
Construction Technologies	Electrical systems	use in conjunction with branch wiring and repair/maintenance of electrical/electronic equipment.
Design Studies	Design modules, including CAD	modules applied when student is designing Electro-Technologies projects.
Fabrication Studies	Welding, sheet metal fabrication, machining	knowledge/skills used in designing and constructing projects using these processes.
Information Processing	Computer/software use, programming, expert systems	broaden the knowledge and skills related to computer technologies.
Mechanics	Electricity/Electronics related modules	apply electronic knowledge and skills to vehicle electrical/electronic systems.

Note that project, practicum and safety modules from Career Transitions strand may be combined with modules from Electro-Technologies strand to provide increased opportunities for students to develop expertise and refine their competencies in a particular area of study, such as:

- acquiring safety skills and credentials
- enhancing specific electronic and electrical skills
- completing activities beyond the constraints of a module; e.g., Digital Technology Application, Analog Communication III, Amplifiers, Robotics projects
- preparing for apprenticeship linkages by improving proficiencies in areas that require upgrading and development.

For a sample of a CTR Project module that has been developed as an extension to an existing module, refer to pages H.4 to H.5.

Linkages between Electro-Technologies modules and other strands and across the curriculum have also been identified. Refer to "Electro-Technologies: Connections With Other CTS Strands," and "Electro-Technologies Connections Across the Curriculum."

In addition, modules may be aligned according to the course emphasis and themes that run between modules and strands as outlined in "Electro-Technologies: Junior High School Module Clusters."

For a summary of modules that can be combined with Electro-Technologies from other strands, refer to "Electro-Technologies: Extended Scope and Sequence."

With Other Secondary Programs

For learnings to have relevance, it is important to integrate core and complementary programs with Electro-Technologies. Many of the Electro-Technologies competencies apply and reinforce learnings in other areas.

The following chart provides specific examples of linkages between Electro-Technologies and other secondary programs:

Subject	Linkage
CALM	Career assessment and preparation.
Drama	Recording, sound system, lighting system, design, set-up and operation.
Language Arts	Technical report writing, report presentations, resume writing, interviews, portfolio development.
Mathematics	Basic mathematics, percentages, ratio/proportion, square roots, algebra, logarithms, trigonometry, vectors.
Science/Physics	Electricity, motors, energy consumption, matter/energy in chemical change, electric forces and fields, magnetic forces and fields, waves and particles.

With Practical Arts Courses

Modules in the Electro-Technologies strand replace the existing junior and senior high practical arts programs. A detailed correlation of the Electro-Technologies strand modules to the related practical arts courses can be found in this section (see "Electro-Technologies: Correlations to Junior/Senior High School Practical Arts Programs").

TRANSITIONS

To the Community/Workplace

The Electro-Technologies program recognizes the aspect of common electrical/electronic content/skills that exist for many of the occupations in this field. Intermediate and advanced modules assist students in developing knowledge, skills and attitudes required to make the transition into occupations in Alberta's electrical/electronic industries. Some career sectors welcome students with a common core background and are equipped for further training on the job.

Students are advised to consider Work Experience, Work Study or Cooperative

Education programs. These programs provide relevance and practicality to classroom learning and make linkages with labour, business and industry. Students will also be provided with a clearer understanding of expectations in the Electro-Technologies field.

In addition, information from the National Occupational Classification (NOC) regarding occupations in related areas that can be accessed upon completion of high school is provided in this section (see "Electro-Technologies: Related Occupations").

To Related Post-secondary Programs

The themes and modules offered in Electro-Technologies are consistent with many of the pre-employment and apprenticeship courses now being offered by post-secondary institutions.

A number of articulation agreements have been established with post-secondary institutions in Alberta. These agreements provide preferred entrance and/or advanced standing/credit for CTS students who have successfully completed designated modules. A current summary of articulation agreements in place that involve CTS modules is available through Alberta Education's web site <http://ednet.edc.gov.ab.ca>. For further information regarding particular articulation agreements, contact the post-secondary institution and/or review its calendar.

CTS courses in Electro-Technologies may also link with one or more of Alberta's Apprenticeship Training Programs; e.g., Electrician, Electronic Technician. Students who are employed as an apprentice in one of these trade areas and have successfully completed designated CTS modules may also qualify, upon the recommendation of their employer, for a portion of the in-school training component. A summary of articulation agreements established for specific apprenticeship trades (including a correlation to CTS modules) is available through Alberta Education's web site. Further information regarding apprenticeship linkages can be obtained by contacting Alberta Advanced Education and Career Development, Apprenticeship and Industry Training Division.

An outline of post-secondary institutions in Alberta currently offering programs related to Electro-Technologies can be found in this section (see "Electro-Technologies: Summary of Related Post-secondary Programs").

CREDENTIALLING

Students may earn credentials recognized in the workplace and/or post-secondary institutions by demonstrating specified competencies within the CTS curriculum. The Electro-Technologies strand provides opportunities for students to develop competencies related to:

- Explosive Actuated Tools
- Construction Safety Training
- Emergency First Aid
- CPR, Level C
- Workplace Hazardous Materials Information System
- Transportation of Dangerous Goods.

Further information regarding credentialling in Electro-Technologies is provided in this section (see "Credentialling Opportunities in Electro-Technologies").

MODULE CTR2110: PROJECT 2A – RESIDENTIAL WIRING

Level: Intermediate

Theme: Career Extensions

Prerequisite: ELT2030 Branch Circuit Wiring (Recommended)

Module Description: Students, through projects, extend and enhance competencies developed in the Career Transitions strand or other Career and Technology Studies strands to contexts that are personally relevant.

Module Parameters: Students should have access to basic hand tools, multimeter, related resources and supplies and must have access to instruction from an individual with journeyman qualifications when project is hardwired to main power source and for permanent use.

Through projects, students extend and enhance competencies developed in Career Transitions or other CTS strands to contexts that are personally relevant.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• propose, manage and assess a project • meet goals as defined within the project plan	• successful completion of project, including project: – proposal – management – completion – assessment – presentation. *Assessment Tool* *CTR Project: Career Extensions Modules*	 20 20 20 20 20
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

MODULE CTR2110: PROJECT 2A – RESIDENTIAL WIRING (continued)

Concept	Specific Learner Expectations	Notes
Project Definition	*The student should:* • identify a project • outline related issues and implications • prepare a project plan: – clarify the purposes of the project – define project deliverables – specify project timelines; e.g., key decision points, consultation points – define resource needs; e.g., materials, costs, support network • identify and comply with all related health and safety standards • define assessment standards (indicators for success) • present project proposal • obtain necessary approvals.	Develop skills necessary to install: – service panel – receptacles including GFI circuit – lighting fixture – switches including three-way – low voltage cable and units including door bell, TV cable, telephone – remote control circuit (e.g., garage door).
Project Management	• proceed with the project as outlined by the project plan • monitor project and make necessary adjustments to project plan.	Project monitoring should include regular progress checks and consultation with teacher and others.
Project Presentation and Assessment	• present the project: – outcomes attained – relationship to goals set originally • assess the project: – processes and strategies used – recommendations for how the project could have been improved.	Project presentation could be in print, a display of the project or a description of the processes undertaken. Student assessment could be print, verbal, and/or audio visual.

Electro-Technologies Modules	Agriculture	Career Transitions	Communication Technology	Community Health	Construction Technologies	Cosmetology Studies	Design Studies	Energy and Mines	Enterprise and Innovation	Fabrication Studies	Fashion Studies	Financial Management	Foods	Forestry	Information Processing	Legal Studies	Logistics	Management and Marketing	Mechanics	Tourism Studies	Wildlife
	Other CTS Strands																				
Theme: Fabrication and Service Principles																					
ELT1010: Electro-assembly 1	▤	▤	▤				▤								▤				▤		
ELT2010: Electro-assembly 2		▤					▤		▤						▤				▤		
ELT2020: Electrical Servicing	▤	▤		▤				▤	▤										▤		
ELT3010: Electro-assembly 3		▤					▤		▤						▤				▤		
ELT3020: Electronic Servicing	▤	▤		▤				▤	▤										▤		
Theme: Power Systems																					
ELT1030: Conversion & Distribution		▤																	■		
ELT1050: Electronic Power Supply 1		▤					▤			▤					▤				▤		
ELT2030: Branch Circuit Wiring		▤		▤	■		▤		▤	▤					▤				▤		
ELT2050: Electronic Power Supply 2		▤					▤			▤					▤						
ELT3030: Power Systems & Services		▤					▤								▤				▤		
ELT3040: Generation/Transformation		▤																	▤		
Theme: Computer Logic Systems																					
ELT1060: Digital Technology 1		▤																	▤		
ELT1080: Control Systems 1	▤	▤																	■		
ELT2060: Digital Technology 2		▤	▤				▤												▤		
ELT2070: Computer Technology	▤	▤	▤												▤				▤		
ELT2080: Control Systems 2	▤	▤																	■		
ELT3060: Digital Technology 3		▤	▤																▤		
ELT3070: Digital Applications		▤																	▤		
ELT3080: Microprocessors	▤	▤	▤												■				▤		
ELT3090: Microprocessor Interface	▤	▤	▤				▤			▤					■				▤	▤	
Theme: Communication Systems																					
ELT1090: Analog Communication 1		▤																	■		
ELT1100: Electronic Communication		▤	▤																▤		▤
ELT1110: Security Systems 1	▤	▤																	▤		
ELT2090: Analog Communication 2		▤	▤				▤								▤						
ELT2100: Radio Communication		▤					▤								▤						
ELT2110: Security Systems 2	▤	▤		▤			▤								▤				▤		
ELT2120: Electro-optics		▤					▤												▤		
ELT3100: Analog Communication 3		▤					▤								▤						
ELT3110: Amplifiers		▤					▤								▤				▤		
ELT3130: Data/Telemetry Systems		▤					▤								▤				▤		
Theme: Robotic and Control Systems																					
ELT1130: Robotics 1		▤																	▤		
ELT2130: Magnetic Control Devices		▤					▤								▤				▤		
ELT2140: Robotics 2		▤					▤			▤					▤						
ELT2150: Electronic Controls	▤	▤					▤								▤				▤		
ELT3140: Motors	▤	▤																	■		
ELT3150: Robotics 3		▤					▤								▤						
ELT3160: Control Applications	▤	▤																	▤		

■ Provides many direct links with competencies in this strand. Students will reinforce, extend and apply a substantial number of knowledge and/or skill components in practical situations.

▤ Provides some links with competencies developed in this strand, usually through the application of related technologies and/or processes.

Across the Curriculum

Electro-Technologies Modules	Junior High							Senior High											
	Language Arts	Social Studies	Mathematics	Science	Health & PLS	Physical Education	Fine Arts	English	Social Studies	Mathematics	Science (General)	Biology	Chemistry	Physics	CALM	Physical Education	Fine Arts	Social Sciences	Second Language
Theme: Fabrication and Service Principles																			
ELT1010: Electro-assembly 1				▤						▤	■			▤	▤				
ELT2010: Electro-assembly 2	▤			▤				▤		▤	▤			▤	▤				
ELT2020: Electrical Servicing	▤		▤					▤		▤	▤			▤	▤				
ELT3010: Electro-assembly 3										▤	▤			▤	▤				
ELT3020: Electronic Servicing			▤					■		▤	▤			▤	▤				
Theme: Power Systems																			
ELT1030: Conversion & Distribution	▤		▤	■				▤		▤	■			▤	▤				
ELT1050: Electronic Power Supply 1	▤		▤	▤				▤		▤	▤			▤	▤				
ELT2030: Branch Circuit Wiring							▤				▤			▤	▤		▤		
ELT2050: Electronic Power Supply 2								▤			▤			▤	▤				
ELT3030: Power Systems & Services														▤	▤				
ELT3040: Generation/Transformation														▤	▤				
Theme: Computer Logic Systems																			
ELT1060: Digital Technology 1	▤		▤	▤				▤						▤	▤				
ELT1080: Control Systems 1	▤		▤	▤				▤						▤	▤				
ELT2060: Digital Technology 2				▤				▤						▤	▤				
ELT2070: Computer Technology				▤				▤						▤	▤				
ELT2080: Control Systems 2				▤				▤						▤	▤				
ELT3060: Digital Technology 3								▤						▤	▤				
ELT3070: Digital Applications								▤						▤	▤				
ELT3080: Microprocessors								▤						▤	▤				
ELT3090: Microprocessor Interface								▤						▤	▤				
Theme: Communication Systems																			
ELT1090: Analog Communication 1	▤		▤	▤				▤		▤				▤	▤				
ELT1100: Electronic Communication	▤		▤	▤				▤		▤				▤	▤				
ELT1110: Security Systems 1	▤		▤	▤				▤		▤				■	▤				
ELT2090: Analog Communication 2				▤				▤						▤	▤				
ELT2100: Radio Communication				▤				▤						▤	▤				
ELT2110: Security Systems 2				▤				▤						▤	▤				
ELT2120: Electro-optics				▤				▤						▤	▤				
ELT3100: Analog Communication 3								▤						▤	▤				
ELT3110: Amplifiers								▤						▤	▤				
ELT3130: Data/Telemetry Systems								▤						▤	▤				
Theme: Robotic and Control Systems																			
ELT1130: Robotics 1	▤		▤	▤		▤			▤					▤	▤				
ELT2130: Magnetic Control Devices				▤		▤								▤	▤				
ELT2140: Robotics 2				▤		▤								▤	▤				
ELT2150: Electronic Controls				▤		▤								▤	▤		▤		
ELT3140: Motors				▤		▤								▤	▤				
ELT3150: Robotics 3						▤								▤	▤				
ELT3160: Control Applications						▤								▤	▤				

Provides many direct links with course content. Students will reinforce, extend and apply a substantial number of knowledge and/or skill components in practical contexts. ■

Provides some links with course content, usually through the application of related technologies and/or processes. ▤

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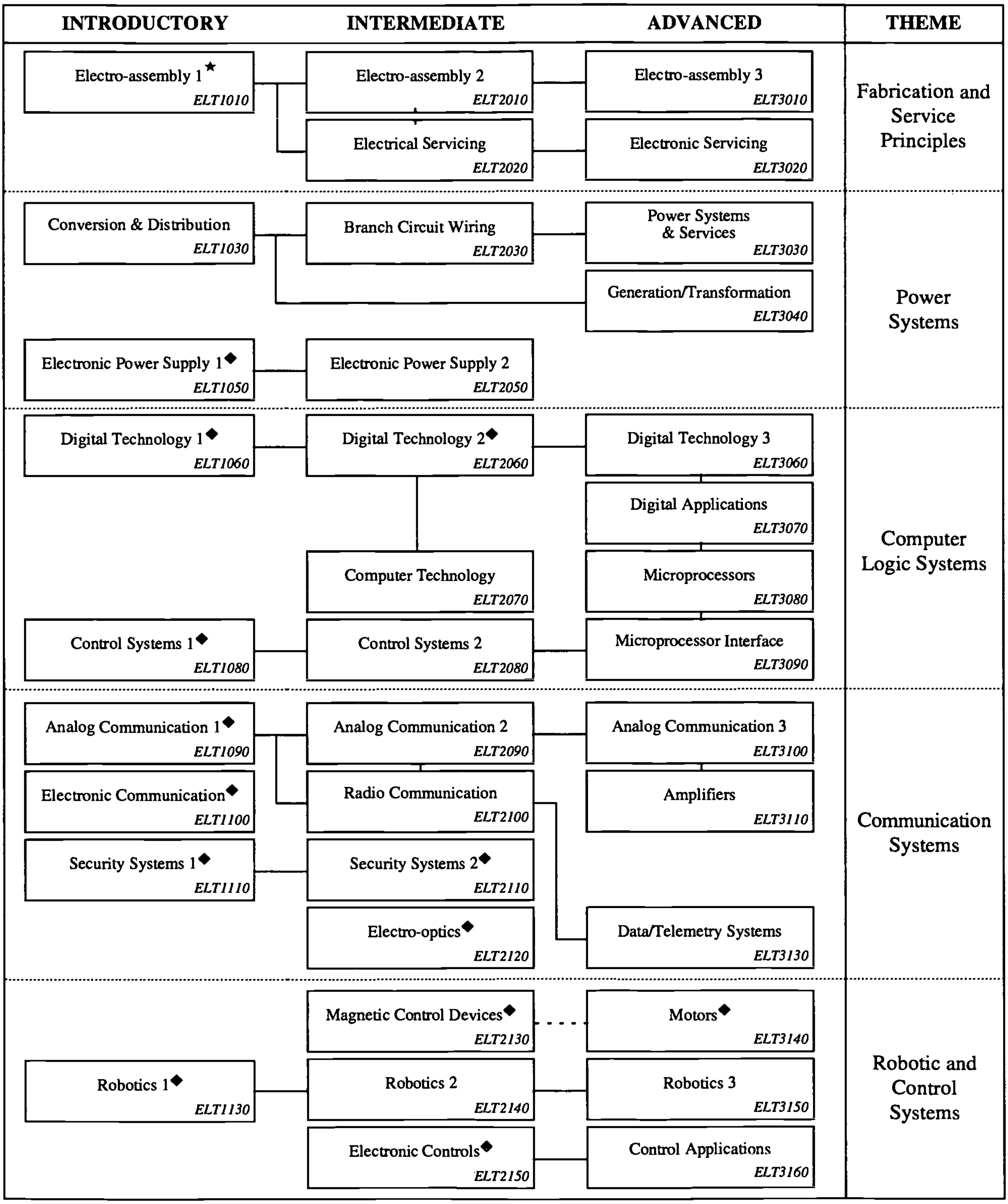
LINKAGES – *Electro-Technologies: Junior High School Module Clusters*

Course Emphasis	Electro-Technologies Modules	Mechanics Modules	Design Studies Modules	Construction Technologies Modules
Electrical/ Electronic Principles (3 modules)	Electro-assembly 1 *ELT1010* Conversion & Distribution *ELT1030*	Electrical Fundamentals *MEC1090*		
Design/Prototyping (4 modules)	Electro-assembly 1 *ELT1010*	Modes & Mechanisms *MEC1010*	Sketch, Draw & Model *DES1010*	Basic Tools & Materials *CON1010*

Course Emphasis	Electro-Technologies Modules	Information Processing Modules	Design Studies Modules	Construction Technologies Modules
Computers/Uses (5 modules)	Digital Technology 1 *ELT1060* Computer Technology *ELT2070*	Computer Operations *INF1010* Keyboarding 1 *INF1020*	CAD Fundamentals *DES1050*	

Course Emphasis	Electro-Technologies Modules	Mechanics Modules	Energy & Mines Modules	Construction Technologies Modules
Energy Conversion/Uses (6 modules)	Electro-assembly 1 *ELT1010* Conversion & Distribution *ELT1030* Electronic Power Supply 1 *ELT1050*	Electrical Fundamentals *MEC1090*	Overview of Alberta Geology *ENM1010*	Basic Tools & Materials *CON1010*

Electro-Technologies: *Scope and Sequence*



——— Prerequisite   - - - - Recommended sequence

★ Module provides a strong foundation for further learning in this strand.

◆ Refer to specific modules for additional prerequisites.

Electro-Technologies: Extended Scope and Sequence

THEME	INTRODUCTORY	INTERMEDIATE	ADVANCED
Fabrication and Service Principles	Personal Safety (Management) *CTR1210*	Workplace Safety (Practices) *CTR2210*	
	The Design Process *DES1020*	3D Design Applications *DES2020*	2D Design Studio 1 *DES3010*
	2D Design Fundamentals *DES1030*	Technical Drawing Applications *DES2050*	
	CAD Fundamentals *DES1050*	CAD Applications *DES2030*	
	Basic Tools & Materials *CON1010*	Print Reading *FAB2020*	
		Sheet Fabrication 2 (Machine Processes) *FAB2090*	
Power Systems	Nonrenewable Resources *ENM1020*	Renewable Energy Technology *ENM2050*	Sustainable Energy (The Power & Potential) *ENM3050*
	Building Construction *CON1070*	Electrical Systems *CON2070*	Energy Efficient Housing *CON3080*
	Electrical Fundamentals *MEC1090*	Electrical Components *MEC2090*	
Computer Logic Systems	Computer Operations *INF1010*	Ignition Systems *MEC2060*	Computer Systems *MEC3090*
	Word Processing 1 *INF1030*	Emission Controls *MEC2070*	
	Programming 1 *INF1080*	Programming 2 *INF2150*	Programming Application 1 *INF3150*
			Expert Systems *INF3140*
Communication Systems	Audio/Video Production 1 *COM1060*	Audio/Video 1 *COM2090*	Video 3 *COM3110*
	Animation 1 *COM1070*	Digital Design 2 *COM2120*	Digital Design 3 *COM3130*
	Information Highway 1 *INF1090*	Information Highway 2 *INF2200*	
Robotic and Control Systems	Logistics *LOG1010*	CNC Turning (Computer Numeric Control) *FAB2150*	CNC Milling (Computer Numeric Control) *FAB3150*
	Production Systems *FAB1160*	Inventory Management 1 *LOG2040*	Inventory Management 2 *LOG3040*

Introductory, Intermediate and Advanced Modules	ELT1010: Electro-assembly 1	ELT1030: Conversion & Distribution	ELT1050: Electronic Power Supply 1	ELT1060: Digital Technology 1	ELT1080: Control Systems 1	ELT1090: Analog Communication 1	ELT1100: Electronic Communication	ELT1110: Security Systems 1	ELT1130: Robotics 1	ELT2010: Electro-assembly 2	ELT2020: Electrical Servicing	ELT2030: Branch Circuit Wiring	ELT2050: Electronic Power Supply 2	ELT2060: Digital Technology 2	ELT2070: Computer Technology	ELT2080: Control Systems 2	ELT2090: Analog Communication 2	ELT2100: Radio Communication	ELT2110: Security Systems 2	ELT2120: Electro-optics	ELT2130: Magnetic Control Devices	ELT2140: Robotics 2	ELT2150: Electronic Controls	ELT3010: Electro-assembly 3	ELT3020: Electronic Servicing	ELT3030: Power Systems & Services	ELT3040: Generation/Transformation	ELT3060: Digital Technology 3	ELT3070: Digital Applications	ELT3080: Microprocessors	ELT3090: Microprocessor Interface	ELT3100: Analog Communication 3	ELT3110: Amplifiers	ELT3130: Data/Telemetry Systems	ELT3140: Motors	ELT3150: Robotics 3	ELT3160: Control Applications
Junior High Industrial Education																																					
Electricity	X	X																																			
Electronics	X	X			X	X	X																														
Computers				X	X		X	X	X																												
Power Technology 10, 20, 30 (1 credit)																																					
Non-conventional Power Sources	X	X																																			
Electrical & Electronic systems																																			X		
Appliance Repair & Troubleshooting											X																										
Electricity Electronics 10, 20, 30																																					
Basic Electricity & Electronics I	X	X																																			
Basic Electronics II			X	X		X																															
Equipment Servicing	X		X					X			X																										
Logic Circuits				X										X																							
Computer Systems															X																						
Introduction to Computers															X																						
Computer Programming - Introductory	Information Processing Module																																				
Communications - Introductory						X																															
Communications - Systems																		X																			
Electronic Design										X																											
Electronic Construction										X																											
Vocational - 5 Credits																																					
Electricity-Electronics 12	X	X				X			X																												
Electricty 22A			X	X																																	
Electricity 22B												X																									
Electricity 22C											X																										
Electricity 32A					X						X															X	X										
Electricity 32B																											X								X		
Electricity 32C													X																								
Electronics 22A		X	X										X					X								X	X										
Electronics 22B																X	X																				
Electronics 22C				X										X		X					X																
Electronics 32A			X			X											X	X															X	X			
Electronics 32B													X					X							X								X				
Electronics 32C															X																X	X					
Related Mechanics 22C											X																										

★ September, 1997: All practical arts courses replaced by Career and Technology Studies.

TRANSITIONS – *Electro-Technologies: Related Occupations*

Information for this chart was obtained from the National Occupational Classification (NOC) descriptions.

Educational Requirements:

D: High School Education
C: Apprenticeship
B: College or Vocational Education
A: University

Occupation Profile	NOC#	D	C	B	A
Audio and Video Recording Technicians	5225	✓		✓	
Avionics Technician	2244			✓	✓
Broadcast Technician	5224			✓	
Cable Television Service and Maintenance Technicians	7247	✓		✓	
Communication Electrician	7246			✓	
Contractors and Supervisors, Electrical Trades and Telecommunication Occupations	7212		✓		
Electric Appliance Servicers and Repairers	7332		✓		
Electrical and Electronic Engineers	2133				✓
Electrical Engineering Technologist	2241			✓	
Electrician	7241		✓		
Electrical Mechanic	7333		✓		
Electrical Power Line and Cable Workers	7352		✓		
Electrical Rewind Mechanic	7333/2242		✓		
Electronic Technician	2241		✓		
Electronics Engineering Technologist	2241			✓	
Electronic Service Technicians (Household and Business Equipment)	2242		✓	✓	
Fiber Optics Technician	2241			✓	
Industrial Electricians	7242			✓	
Laser Technician	2241			✓	
Meter Reader	1454	✓			
Power Lineman	7244		✓		
Power System Electrician	7243		✓		
Power Systems and Power Station Operators	7352		✓	✓	
Stationary Engineers and Auxiliary Equipment Operators	7351		✓	✓	
Supervisors, Electrical Products Manufacturing	9223	✓			
Supervisors, Electronics Manufacturing	9222	✓		✓	
Telecommunications Installation and Repair Workers	7246	✓		✓	
Telecommunications Line and Cable Workers	7245		✓	✓	
Utilities Manager	9227			✓	✓

	PUBLIC COLLEGES												PRIVATE COLLEGES					TECH. INST.			UNIVERSITIES			VOCATIONAL COLLEGES			
	Alberta College of Art & Design	Fairview College	Grande Prairie Regional College	Grant MacEwan Community College	Keyano College	Lakeland College	Lethbridge Community College	Medicine Hat College	Mount Royal College	Olds College	Red Deer College	**APPRENTICESHIP TRADE**	Augustana University College	Canadian Union College	Concordia College	King's University College, The	North American Baptist College	Northern Alberta Institute of Technology	Southern Alberta Institute of Technology	Banff Centre	University of Alberta	University of Calgary	University of Lethbridge	AVC - Calgary	AVC - Edmonton	AVC - Lac La Biche	AVC - Lesser Slave Lake
Aeronautical/Mechanical Engineering Technology																			CD (3y)								
Aviation/Avionics Technology								D	D		D							C	D								
Audio/Visual Communications	D(4y)			D				D(3y) 3t									V		VD		BM						
Cinema, Radio and Television Arts				D			D		D									D	D	V							
Computer Applications (incl. CAD)							D	CD 1t						1t				VC D	V					4w			
Computer Maintenance/Repair																		CD	V								
Computer Engineering Technologies (Hardware)							CD	D										D	VD		BM Phd						
Electrical/Electronic Engineering Technologies (incl. Broadcast, Industrial, Instrumentation and Telecommunications)							CD											CD	D								
Engineering (Civil, Computer, Electrical, Physics)			1t		1t			1t	1t 2t		1t			2t	1t						BM PhD	DBM PhD	1t				
Engineering Drafting/Design							D											CD	VCD								
Mechanical Engineering							D											D	D								

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	PUBLIC COLLEGES												PRIVATE COLLEGES					TECH. INST.			UNIVERSITIES			VOCATIONAL COLLEGES			
	Alberta College of Art & Design	Fairview College	Grande Prairie Regional College	Grant MacEwan Community College	Keyano College	Lakeland College	Lethbridge Community College	Medicine Hat College	Mount Royal College	Olds College	Red Deer College	**APPRENTICESHIP TRADE**	Augustana University College	Canadian Union College	Concordia College	King's University College, The	North American Baptist College	Northern Alberta Institute of Technology	Southern Alberta Institute of Technology	Banff Centre	University of Alberta	University of Calgary	University of Lethbridge	AVC - Calgary	AVC - Edmonton	AVC - Lac La Biche	AVC - Lesser Slave Lake
Telecommunications Engineering Technology																		CD	D								
Appliance Serviceman												3y															
Communication Electrician												4y															
Electrical Rewind Mechanic												4y															
Electrician (including Electronic Technician, Instrument Mechanic and Power System Electrician)		V			8w	C					30w	4y															C(12w)
Power Lineman												4y															

CODES:						
B	Bachelor's Degree	D	Diploma (2 years)	w	weeks
M	Master's Degree	V	Varies	m	months
Ph.D.	Doctoral Degree	1t	One-year transfer	y	years
C	Certificate (1 year or less)	2t	Two-year transfer		

*Information adapted from "It's About Time: To Start Thinking About Your Future", Advanced Education and Career Development, 1995.

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BEST COPY AVAILABLE

CREDENTIALLING – *Electro-Technologies: Credentialling Opportunities*★

The following credentialling opportunities link with modules in Electro-Technologies and other strands.

Certificate	Agency	Linking Modules	Instructor Qualifications	Comments
Explosive Actuated Tools (EAT)	Technical Institute or College (post-secondary)	Concrete Work (Structures & Finishing) (CON3010)	EAT certificate	Required by OH&S for all operators to be certified Formal credentialling to be arranged through local college or technical institute.
Construction Safety Training System	Alberta Construction Safety Association	Site Management (CON3110)	Alberta Construction Safety Association Trainer	Can be offered through a CD ROM Interactive Video Computer system
Emergency First Aid	St. John Ambulance Canadian Red Cross	Personal Safety (Management) (CTR1210)	Certified First Aid/CPR Instructor	Three-year nationally recognized certificate
CPR Level C	St. John Ambulance Canadian Red Cross	Practicum modules (CTR Practicum Modules A-E, CTR3040–3080)	CPR Instructors	Nationally recognized certification "Basic Rescuer" includes airway management and CPR for adults, children, infants and 2-rescuer adult CPR (12 hours)
Workplace Hazardous Materials Information Systems (WHMIS)	Occupational Health and Safety	Personal Safety (Management) (CTR1210)	WHMIS Instructor	Addresses skills required to work safely with hazardous materials
Transportation of Dangerous Goods (TDG)	Occupational Health and Safety	Workplace Safety (Practices) (CTR 2210)	TDG Instructor	Addresses skills required by individuals involved with the transportation and handling of dangerous goods

★Further information regarding these and other credentialling opportunities available to CTS students is available through Alberta Education's web site <http://ednet.edc.gov.ab.ca>.

ELECTRO-TECHNOLOGIES

SECTION I: LEARNING RESOURCE GUIDE

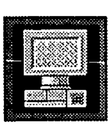
This section of the GSI has been designed to provide a list of resources that support student learning.

Three types of resources are identified:

- Authorized: Resources authorized by Alberta Education for CTS curriculum; these resources are categorized as basic, support, or teaching
- Other: Titles provided as a service to assist local jurisdictions to identify resources that contain potentially useful ideas for teachers. Alberta Education has done a preliminary review of these resources, but further review will be necessary prior to use in school jurisdictions
- Additional: A list of local, provincial and national sources of information available to teachers, including the community, government, industry, and professional agencies and organizations.

The information contained in this Guide, although as complete and accurate as possible as of June 1997, is time-sensitive.

For the most up-to-date information on learning resources and newer editions/versions, consult the LRDC *Buyers Guide* and/or the agencies listed in the Distributor Directory at the end of this section.



CTS is on the Internet.
Internet Address:
http://ednet.edc.gov.ab.ca

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INTRODUCTION

CTS AND THE RESOURCE-BASED CLASSROOM

Career and Technology Studies (CTS) encourages teachers to establish a resource-based classroom, where a variety of appropriate, up-to-date print and nonprint resources are available. Learning resources identified for CTS strands include print, software, video and CD-ROM formats. Also of significance and identified as appropriate throughout each strand are sources of information available through the Internet.

The resource-based classroom approach accommodates a variety of instructional strategies and teaching styles, and supports individual or small group planning. It provides students with opportunities to interact with a wide range of information sources in a variety of learning situations. Students in CTS are encouraged to take an active role in managing their own learning. Ready access to a strong resource base enables students to learn to screen and use information appropriately, to solve problems, to meet specific classroom and learning needs, and to develop competency in reading, writing, speaking, listening and viewing.

PURPOSE AND ORGANIZATION OF THIS DOCUMENT

The purpose of this document is to help teachers identify a variety of resources to meet their needs and those of the students taking the new CTS curriculum. It is hoped that this practical guide to resources will help teachers develop a useful, accessible resource centre that will encourage students to become independent, creative thinkers.

This document is organized as follows:

- Authorized Resources:
  - basic learning resources
  - support learning resources
  - teaching resources
- Other Resources
- Additional Sources.
- Distributor Directory.

Some resources in the guide have been authorized for use in some or all of the CTS strands, e.g., the Career and Technology Studies video series produced by ACCESS: The Education Station. Further information is provided in relevant sections of this resource guide.

Each resource in the guide provides bibliographic information, an annotation where appropriate, and a module correlation to the CTS modules. The distributor code for each entry will facilitate ordering resources. It is recommended that teachers preview all resources before purchasing, or purchase one copy for their reference and additional copies as required.

Distributor Code	Resources		Levels/Mod. No.		
			1	2	3
ACC	Title	Author	1010	2010	3010
	Bibliographic Information				
	Annotation				

Distributor Code - see Distributor Directory

1 = Introductory
2 = Intermediate
3 = Advanced

Indicates module number

HOW TO ORDER

Most authorized resources are available from the Learning Resources Distributing Centre (LRDC) at:

12360 – 142 Street
Edmonton, AB T5L 4X9
Telephone: 403–427–5775 (outside of Edmonton dial 310–0000 to be connected toll free)
Fax: 403–422–9750
Internet: http://ednet.edc.gov.ab.ca/lrdc

Please check LRDC for availability of videos.

RESOURCE POLICY

Alberta Education withdraws learning and teaching resources from the provincial list of approved materials for a variety of reasons; e.g., the resource is out of print; a new edition has been published; the program has been revised. Under section 44 (2) of the *School Act*, school boards may approve materials for their schools, including resources that are withdrawn from the provincial list. **Many school boards have delegated this power to approve resources to school staff or other board employees under section 45 (1) of the *School Act*.**

For further information on resource policy and definitions, refer to the *Student Learning Resources Policy* and *Teaching Resources Policy* or contact:

Learning Resources Unit, Curriculum Standards Branch
Alberta Education
5th Floor, Devonian Building, East Tower
11160 Jasper Avenue
Edmonton, AB T5K 0L2
Telephone: 403–422–4872 (outside of Edmonton dial 310–0000 to be connected toll free)
Fax: 403–422–0576
Internet: http://ednet.edc.gov.ab.ca

Note: Owing to the frequent revisions of computer software and their specificity to particular computer systems, newer versions may not be included in this guide. However, schools may contact the LRDC directly at 403–427–5775 for assistance in purchasing computer software.

Trademark Notices: Microsoft, Access, Excel, FoxPro, Mail, MS-DOS, Office, PowerPoint, Project, Publisher, Visual Basic, Visual C++, Windows, Windows NT, Word, and Works are either registered trademarks or trademarks of Microsoft Corporation. Apple, Mac, Macintosh, and Power Macintosh are either registered trademarks or trademarks of Apple Computer, Inc. Other brand and product names are registered trademarks or trademarks of their respective holders.

AUTHORIZED RESOURCES

BASIC LEARNING RESOURCES

The following basic learning resources have been authorized by Alberta Education for use in the Electro-Technologies curriculum. These resources address the majority of the learner expectations in one or more modules and/or levels. A curriculum correlation appears in the right-hand column.

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Digital Electronics.* (4th edition.) Roger Tokheim. Glencoe MacMillan/McGraw-Hill Ryerson Ltd., 1994. A systems to sub-systems approach is utilized to introduce digital electronics with the extensive use of medium and large integrated circuits. Small-scale integrated circuits are used where student is introduced to fundamental concepts. A student activity manual and instructor's resource guide with IBM test generator disk are available.	1060	2060 2070 2080	3060 3070 3080 3090
LRDC	*Electronic Fabrication.* (2nd edition.) Gordon Shimizu. Delmar Publishers Ltd., 1990. A comprehensive reference on the design, fabrication and final product preparation of electronic circuit boards.	1010	2010	3010
LRDC	*Electronics for Industrial Electricians.* Stephen L. Herman. Delmar Publishers Inc. Nelson Canada, 1995. This resource provides information from electrical/electronic components to circuit function. An instructor's guide is available.	1060 1080	2060 2080	3150
LRDC	*Electronics Workbench.* (Windows Version 3.0.) Interactive Image Technologies. McGraw-Hill Ryerson Ltd., Electrolab, 1993. Courseware/Print. A simulation software package that constructs schematic analog and digital circuits on a computer display. The program stimulates circuit activity and includes the use of test instruments such as function generator, oscilloscope, bode plotter, multimeters, word generator, logic analyzer, logic converter, built into the program. See 150 Circuits for Use with Electronics Workbench and Practical Teaching Ideas: Enhancing Your Curriculum with Electronics Workbench for support materials.	1050 1060 1080 1090 1100 1110	2050 to 2150	3060 3070 3080 3090 3100 3130 3160

Basic Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Essentials of Electronics: A Survey.* Frank D. Petruzella. Glencoe Division. McGraw-Hill Ryerson, 1994. A comprehensive, well-illustrated resource providing a broad-based approach in electricity/electronics. The resource is organized in selected topics (42 chapters, 670 pages) which correlate with indicated modules providing opportunities to test interest and aptitude on the many facets of electricity/electronics. An instructor's resource guide and activity manual are available.	1050 1060 1080	2050 2060 2080 2090 2110 2130 2140	3100
LRDC	*Mica Soft: Electronics and Microelectronics Tutor.* (DOS Version.) MicaSoft/Electrolab Training Systems. 1993. Software Package. A software package that introduces the student to AC/DC circuits, semi-conductors, diodes, transistors, amplifiers, oscillators, digital logic and microprocessors.	1010 1060 1090 1100	2010 2060 2080 2090 to 2120 2150	3010 3060 3090 3100 3130 3150

SUPPORT LEARNING RESOURCES

The following support learning resources are authorized by Alberta Education to assist in addressing some of the learner expectations of a module or components of modules.

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*150 Circuits for Use With Electronics Workbench.* (DOS/Windows Version 3.0.) Interactive Image Technologies. McGraw-Hill Ryerson Ltd., 1994. Courseware/Print. See Basic Learning Resources for annotation and module correlation.			
LRDC	*1994 Canadian Electrical Code, Part I: Handbook.* Canadian Standards Association. Electrical Contracts Association of Alberta. The Canadian Electrical Code is required in many modules to explain how to install and maintain electrical/electronic systems.	1110	2020 2030	3020 3140
LRDC	*Auto Electricity and Electronics Technology.* J.E. Duffy. The Goodheart-Willcox Co., Inc. Irwin Publishing, 1995. Text and Workbook. The text is divided into four sections and 28 chapters. It reviews electrical fundamentals, explains the construction and operation of major electrical-electronic systems. Summarizes how to diagnose, test and repair these same electrical-electronic systems, gives ASE information, useful tables and an index-glossary reference. An instructor's guide is also available.	1060 1080	2060 2080	3060
LRDC	*Basic Electronics.* Malcoum Plant. Pippin Publishing Ltd., 1990. Series of five texts. A series of A-E booklets titled *Introducing Electronics, Resistors / Capacitors / Inductors, Diodes and Transistors, Analog Systems and Digital Systems* which provides a basic introduction ranging from passive to active and digital circuits.	1010 1030 1050 1060 1080 1090 1100	2010 2050 2060 2080 2090 2100	
LRDC	*Basic Wiring for Canada.* Editors of Creative Homeowner Press. Creative Homeowner Press, 1995. Colourful, well-illustrated reference for basic electricity, tools, wiring of buildings, appliances, fixtures and outdoor wiring. Note: Teachers need to check latest Canadian Electrical Code with respect to the use of aluminium wire and grounding receptacles.	1110	2030 2110	

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Build Your Own Home Security Systems.* Delton T. Horn. TAB Books/McGraw-Hill Ryerson Ltd, 1993. Diverse coverage of home security systems is provided, complete with-easy-to follow instructions on how to build 55 different projects.	1110	2110	
LRDC	*Canadian Electrical Code, Part 1: Safety Standards for Electrical Installations, 17th edition. 1994 Handbook* and *What's New in 1994: Changes to the CE Code Part 1.* (Electrical Contractors Association of Alberta.) Canadian Standards Associations, 1994. This reference provides the existing electrical codes required for electrical/electronic installations.	1010 1030 1110	2030 2130 2150	3040 3140 3150
ACC	*Career and Technology Studies: Key Concepts.* Edmonton, AB: ACCESS: The Education Station. A series of videos and utilization guides relevant to all CTS strands. A series consists of: *Anatomy of a Plan; Creativity; Electronic Communication; The Ethics Jungle; Go Figure; Innovation; Making Ethical Decisions; Portfolios; Project Planning; Responsibility* and *Technical Writing.*	all	all	all
LRDC	*Communication Electronics.* (2nd edition.) L.E. Frenzel. Maxwell Macmillan Canada, 1995. Text and Activities Manual. Resource provides introductory basic communication concepts including modulation techniques, equipment descriptions such as transmitters/ receivers, antennas, microwave, modems, area networks, fibre optics, satellite communication, cellular telephone and facsimiles. An instructor's resource guide is available. Note: A slang reference to radar detectors could be viewed as problematic. (Activities Manual 10-2.)		2100	3110
LRDC	*Computers Simplified.* (3rd edition.) (Visual 3D Series.) MaranGraphics' Development Group. Prentice Hall/Ginn Publishing, 1996. This resource is for the novice who may have had limited exposure to computer technology. The resource covers computer basics/architecture, processing, input/output devices, storage devices, application software, portable computers, operating systems, PC/MACINTOSH computers, Internet networks, world wide web, newsgroups, electronic mail and mailing lists. Topics considered are dealt with in one or two sentences, each having extensive color graphics attached. Ten to fifteen percent of each page is text, the remainder graphics.		2020 2070	3080

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No. 1	2	3
LRDC	*Digital Electronics.* (4th edition.) Roger L. Tokheim. Glencoe Division. Macmillan/McGraw-Hill, 1994. Activities Manual. See Basic Learning Resource for annotation and module correlation.			
LRDC	*Electric Circuits and Machines.* (7th edition.) Eugene C. Lister and Robert J. Rusch. Glencoe Macmillan/McGraw-Hill, 1993. A concise, practical survey of fundamental electrical circuits and equipment. An instructor's guide is available.		2080 2130	3030 3040 3140
LRDC	*Electrical Power, Motors, Control, Generators, Transformers.* Joe Kaiser. The Goodheart-Willcox Company Inc., 1991. Text and Student Workbook. Covers the fundamental principles of operation and practical application of motors, generators, transformers, motor controls and generators. A student workbook, instructor's guide and answer key are available. Note: This resource should be supplemented with materials or activities dealing with minority contributions and discussions that address controversial issues regarding electricity us (e.g., dams, nuclear generators).		2130 2150	3030 3040 3130
LRDC	*Electricity 1: Devices, Circuits, and Materials.* (6th edition.) T.S. Kubala. Delmar Publishers. ITP Nelson Canada, 1996. Resource is a good overview of basic circuits and devices with a comprehensive coverage of generators, motors and motor control.	1030	2030 2130	3030 3040 3140
LRDC	*Electricity 2: Devices, Circuits and Materials.* (6th edition.) T.S. Kubala. Delmar Publishers. ITP Nelson Canada, 1996. Resource is a good overview of basic circuits and devices with a comprehensive coverage of generators, motors and motor control.	1030	2030 2130	3030 3040 3140
LRDC	*Electricity 3: Power Generation and Delivery.* (6th edition.) W.N. Alerich and J. Kelijik. Delmar Publishers. ITP Nelson Canada, 1996. Resource is a good overview of basic circuits and devices with a comprehensive coverage of generators, motors and motor control.	1030	2030 2130	3030 3040 3140

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Electricity 4: AC/DC Motors, Controls and Maintenance.* (6th edition.) W.N. Alerich and J. Kelijik. Delmar Publishers. ITP Nelson Canada, 1996. Resource is a good overview of basic circuits and devices with a comprehensive coverage of generators, motors and motor controls.	1030	2030 2130	3030 3040 3140
LRDC	*Electronic Projects to Control Your Home Environment.* (6th edition.) D.T. Horn. Tab Books. McGraw-Hill Ryerson Ltd., 1994. This resource presents 35 home environmental electronic projects. The projects include temperature sensing, liquid/moisture sensing, atmosphere related (wind speed, humidity, air ionizer), light related (light/dark) relays, dimmer/cross fader, photosensitive and other projects like electromagnetic field detection and radioactivity monitors. Included for each project is a suggested parts list, schematic diagram and discussion notes with encouragement for readers to experiment and modify suggested projects. Note: In chapter 6, the author expresses a negative portrayal of "most professionals in this area" in an attempt to emphasize the importance of communication skills.	1010	2010	3010
LRDC	*Electro-Optics.* Heath Kit Educational Systems, Heath Company/Electrolab Training Systems, 1994. Text and Student Workbook (1987). This resource provides an introduction to the field of opto electronics and fibre optics. An instructor's guide is available.		2120	
LRDC	*Electronic Power Control.* Irvin M. Gottlieb. Glencoe Division. Macmillan/McGraw-Hill, 1993. This text provides a vast array of practical circuits for electronic power control. An instructor's guide is available.	1050	2050 2080 2090	
LRDC	*Electronic Principles and Applications.* (4th edition.) Charles A. Schuler, Glencoe Division. Macmillan/McGraw-Hill, 1994. Text and Activities Manual. These publications introduce the student to the principles and applications of linear devices, circuits and systems. An instructor's resource guide (includes test generator disks - IBM version) is available.	1050 1090	2070 2080	

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Electronic Troubleshooting.* (2nd edition.) Terome E. Oleksy. Glencoe/McGraw-Hill Ryerson Ltd., 1990. This text discusses simple circuits and analyzes them using only the math necessary for understanding their operation. The book shows large systems that contain simple circuits such as tape recorders, guitar amps and radios. An instructor's answer key is available.			3010 3020
LRDC	*Elementary Electronics*. Mel Sladdin, Alan Johnson. Hodder & Stoughton. Pippin Publishing Ltd., 1990. Teaches electronics through practical work.	1050 1060 1080		
LRDC	*Essentials of Electronics: A Survey*. Frank D. Petruzella. Glencoe Division. McGraw-Hill Ryerson, 1994. Activity Manual. See Basic Learning Resources for annotation and module correlation.			
LRDC	*Electronics - GCSE Technology*. Steve Rich and Anthony Edwards. Stanley Thornes (Publishers) Ltd. Bacon and Hughes, 1990. Covers a variety of problems and how they may be resolved by different electrical/electronic circuits.	1010 1080	2010 2060 2090	
LRDC	*Foundations of Electronics.* (2nd edition.) R.L. Meade. Delmar Publishers. ITP Nelson Canada, 1994. Text and Laboratory Projects. The resource uses a traditional approach in covering topics such as meters, Ohm's Law, series/parallel circuits, inductance, transformer, capacitance, resonance, power supplies, amplifiers etc. This resource is a comprehensive set of resources including text, laboratory projects, instructor's guide, transparencies, flash cards and a computerized testmaker and testbank for DOS computers. Workbook consists of 89 projects.	1010 1050 1060	2010 2060	3040 3110
LRDC	*Industrial Electronics.* Frank D. Petruzella. Glencoe/McGraw-Hill Ryerson Ltd., 1996. Text and Activity Manual. Provides an introduction to a broad range of industrial electronic circuits and equipment covering areas such as power distribution, power electronics, motor controls, programmable logic controllers and process control systems. An instructor's resource guide is available.	1080	2070 2080 2130 2150	3130 3150

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Laser Technology*. Jim Johnson. Heath Company. Electrolab Training Systems, 1985. Text and Student Workbook. Continuous information on how light with special and unique characteristics can be generated. An instructor's guide is available.		2120	
LRDC	*Making Printed Circuit Boards*. J. Axelson. Tab Books. McGraw-Hill Ryerson, 1993. This resource provides a step-by-step procedure in making PC boards. It covers topics such as: drawing schematic diagrams, creating PC board artwork, transferring artwork to board, drilling and mounting hardware, soldering, repairing/modifying PC boards, and building three sample projects (5 volt power supply, all purpose pulser/flasher, and dual logic probe).	1010	2010	3010
LRDC	*MicroProcessors - Principles and Applications*. (2nd edition.) Charles M. Gilmore. Glencoe/McGraw-Hill, 1996. Text and Activities Manual. A practical introduction to microprocessors and support devices including programming and microprocessor applications.		2070	3070 3080
LRDC	*Mobile Robots: Inspiration to Implementation*. Joseph L. Jones, Anita M. Flynn. A.K. Peters Publishers, 1993. Outlines the different areas of expertise required to build a robotic device.	1130	2140	3140
LRDC	*Modern Electronic Communication*. (5th edition.) Gary M. Miller. Prentice-Hall Inc. Allyn and Bacon Canada, 1996. Text and Laboratory Manual. An in-depth resource using a block diagram approach to describe electronic communications. An instructor's solutions manual with laboratory manual results and transparency masters are available.		2090 2100 2120	3100 3110 3130
LRDC	*Practical Teaching Ideas: Enhancing Your Curriculum with Electronics Workbench*. (DOS/Windows Version.) Interactive Image Technologies. McGraw-Hill Ryerson Ltd., 1994. Courseware/Print. See Basic Learning Resources for annotation and module correlation.			

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Practical VCR Repair.* David T. Ronan. Delmar Publishers. ITP Nelson Canada, 1995. This resource assumes that the student will have prior electronics training in the basics of electricity/electronics. The resource deals specifically with the operation, troubleshooting, maintenance procedures, alignment and repairs using basic tools including the multimeter VHS format VCRs. Topics covered include: video cassette repair, troubleshooting, loader/transport, align tape path, power supplies, motors, optical sensors, microprocessors, schematics.	1010 1100	2020	3020
LRDC	*Programmable Logic Controllers.* Frank D. Petruzella. Glencoe Macmillan/McGraw-Hill, 1989. Text and Workbook/Activity Manual. Provides the underlying principles of the PLC system and information on installing, programming and maintaining a system. An instructor's guide is available.		2060 2150	3160
LRDC	*Quality Hand Soldering and Circuit Board.* Ted H. Smith. Nelson Canada, 1994. Illustrated elementary reference for soldering techniques and the system of soldering.	1010 1050 to 1130	2010 2020 2050 2060 2080 to 2110 2140	
LRDC	*Robot Builders Bonanza, The: 99 Inexpensive Robotic Projects.* Gordon McComb. Tab Books, McGraw-Hill Ryerson, 1987. This book provides an educational and fun approach to design and construction of robots. Note: That the technologies (hardware) may have changed since the publication of this resource, but basic procedures and components in robotics are still relevant.	1130	2060 2080 2140	
LRDC	*Robotics and Automated Systems.* R.L. Hoekstra. Delmar Publishers. ITP Nelson Canada, 1986.	1060 1080 1130	2060 2080 2130 2140 2150	3080 3090 3140 3150 3160

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Technician's Guide to Fiber Optics.* (2nd edition.) D.J. Sterling. Delmar Publishers. ITP Nelson Canada, 1993. Resource covers the design and implementation of fibre optics. Includes chapters on background, fiber optic components, fibre optic systems. The closing chapter is on test equipment requirements. An instructor's guide is available.	1100	2120	
LRDC	*Today's Electrician: Classroom Manual for Automotive Computer Systems.* D. Knowles and J. Erjavec. Delmar Publishers. ITP Nelson Canada, 1996. This resource provides a step-by-step instructions for diagnosing and repairing computer-controlled ignition, fuel, instrument, air bag, transmission, antilock brakes, air conditioning systems. Each chapter consists of performance objectives, caution and warnings, customer care, tool lists, service tips, case studies, terms to know, diagnostic charts and review questions. Numerous graphics and photo sequences to illustrate specific tasks are used. A shop manual is included (see Teaching Resources).	1060 1080	2060 2070 2080	3080 3090
LRDC	*Tron.ix Basic Concepts and Components.* G. Gibson. Practrak Inc. Simmonds/Cardinal, 1996. This manual is full of appropriate projects for students to build and test. Consists of 19 well-illustrated projects from multi-vibrator blinker to IC Nose-Beeper and seven lessons using a digital multi-meter.	1080	2080	3100
LRDC	*Troubleshooting & Repairing PC Drives & Memory Systems.* S.J. Bigelow. Windcrest/McGraw-Hill, 1994. Provides a basic understanding of computers and memory devices. Besides basic concepts and principles, it provides information on tools/equipment required for repairs, troubleshooting. Covers solid-state memory devices, floppy disc drives, hard disc drives, memory cards, tape drives and optical drives.		2020 2070	3020 3070
LRDC	*Troubleshooting and Repairing Computer Monitors.* S.J. Bigelow. McGraw-Hill, 1995. The text provides an overview of monitor concepts, technology, internal assemblies and operation.. The resource covers monochrome, colour LCDs/plasma panel circuits and repair tools and equipment, troubleshooting and repair procedures. A companion computer software disk is also available.		2020	3020

Support Learning Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Troubleshooting and Repairing Personal Computers*. Art Margolis. Glencoe/McGraw-Hill, 1994. Provides intellectual tools required to troubleshoot and correct malfunctioning hardware and software problems. Helpful tips are provided in solving intermittent problems. An instructor's guide is available.		2060 2070	3020
LRDC	*Troubleshooting Electric Motors*. Glen A. Mazur, Thomas E. Proctor. American Technical Publishers Inc., 1993. A resource for design, operation and troubleshooting electric motors. An instructor's guide is available.			3020 3030 3140
LRDC	*What's New in 1994: Changes to the CE Code Part I (Explained.)* Canadian Standards Association, 1994. The Canadian Electrical code is required in many modules to explain how to install and maintain electrical/electronic systems.	1110	2020 2030	3020 3140

TEACHING RESOURCES

The following teaching resources are authorized by Alberta Education to assist teachers in the instructional process.

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Auto Electricity and Electronics Technology.* J.E. Duffy. The Goodheart-Willcox Co., Inc. Irwin Publishing, 1995. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			
LRDC	*Communication Electronics.* (2nd edition.) L.E. Frenzel. Maxwell Macmillan Canada, 1995. Instructor Resource Manual. See Support Learning Resources for annotation and module correlation.			
LRDC	*Digital Electronics.* (4th edition.) Roger L. Tokheim. Glencoe Division. Macmillan/McGraw-Hill, 1994. Instructor's Resource Guide with IBM Test Generator Disks. See Basic Learning Resources for annotation and module correlation.			
LRDC	*Electric Circuit and Machines.* (7th edition.) Eugene Lister and Robert J. Rusch. Glencoe Macmillan/McGraw-Hill, 1993. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			
LRDC	*Electrical Power, Motors, Controls, Generators, Transformers.* Joe Kaiser. The Goodheart-Willcox Company Inc., 1991. Instructor's Guide and Answer Key. See Support Learning Resources for annotation and module correlation.			
LRDC	*Electro-Optics.* Heathkit Education System, 1987. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			
LRDC	*Electronic Power Control.* Irwin M. Gottlieb. Glencoe Division Macmillan/McGraw-Hill Ryerson Ltd., 1993. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			

Teaching Resources (continued)

Distributor Code	Resources	Levels/Module No.		
		1	2	3
LRDC	*Electronic Troubleshooting.* (2nd edition.) Thorne E. Oleksy. Glencoe/McGraw-Hill Ryerson Ltd., 1990. Instructor's Answer Key. See Support Learning Resources for annotation and module correlation.			
LRDC	*Electronics for Industrial Electricians.* Stephen L. Herman. Delmar Publishers Inc. Nelson Canada, 1995. Instructor's Guide. See Basic Learning Resources for annotation and module correlation.			
LRDC	*Electronics Principles and Applications.* (4th edition.) Charles A. Schuler, Glencoe Division Macmillan/McGraw-Hill Ryerson LTD., 1994. Instructor's Resource Guide (includes test generator disks - IBM version). See Support Learning Resources for annotation and module correlation.			
LRDC	*Essentials of Electronics: A Survey.* Frank D. Petruzella. Glencoe Division. McGraw-Hill Ryerson, 1994. Instructor's Resource Guide. See Basic Learning Resources for annotation and module correlation.			
LRDC	*Foundations of Electronics.* (2nd edition.) R.L. Meade. Delmar Publishers. ITP Nelson Canada, 1994. Instructor's Guide; Computerized Testmaker and Testbank for DOS Compatible Computers; Flash Cards and Transparency Package. See Support Learning Resources for annotation and module correlation.			
LRDC	*Industrial Electronics.* Frank D. Petruzella. Glencoe McGraw-Hill, 1996. Instructor's Resource Guide. See Support Learning Resources for annotation and module correlation.			
LRDC	*Laser Technology.* Jim Johnson. Heath Company, Electrolab Training Systems, 1985. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			

Teaching Resources (continued)

Distributor Code	Resources	Levels/Module No. 1	2	3
LRDC	*Modern Electronic Communication.* (5th edition.) Garry M. Miller, Prentice-Hall Inc. Allyn & Bacon Canada, 1996. Instructor's Solution Manual with Laboratory Manual Results and Transparency Masters. See Support Learning Resources for annotation and module correlation.			
LRDC	*Programmable Logic Controller.* Frank D. Petruzella. Glencoe Macmillan/McGraw-Hill. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			
LRDC	*Robotics and Automated Systems.* R.L. Hoekstra. Delmar Publishers. ITP Nelson Canada, 1986. Instructor's Manual and Key. See Support Learning Resources for annotation and module correlation.			
LRDC	*Technician's Guide to Fiber Optics.* (2nd edition.) D.J. Sterling. Delmar Publishers. ITP Nelson Canada, 1993. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			
LRDC	*Today's Electrician: Shop Manual for Automotive Computer Systems.* D. Knowles and J. Erjavec. Delmar Publishers. ITP Nelson Canada, 1996. See Support Learning Resources for annotation and module correlation.			
LRDC	*Troubleshooting and Repairing Personal Computers.* Art Margolis. Glencoe/McGraw-Hill, 1994. Instructor's guide. See Support Learning Resources for annotation and module correlation.			
LRDC	*Troubleshooting Electric Motors.* Glen A. Mazur, Thomas E. Proctor. American Technical Publishers Inc., 1993. Instructor's Guide. See Support Learning Resources for annotation and module correlation.			

ELECTRO-TECHNOLOGIES RESOURCES

THEME CODE:
A. Fabrications & Service Principles
B. Power Systems
C. Computer Logic Systems
D. Communication Systems
E. Robotic and Control Systems

FORMAT CODE:
p - Print
v - Video
s - Software

STATUS CODE:
B - Basic
S - Support
T - Teaching

LEVEL CODE:
1 - Introductory
2 - Intermediate
3 - Advanced

JR/SR HIGH CODE:
J - Junior High
S - Senior High

Module Number	*Format*	*Status*	*Junior/Senior High*	1010 Electro-assembly 1	1030 Conversion & Distribution	1050 Electronic Power Supply 1	1060 Digital Technology 1	1080 Control Systems 1	1090 Analog Communication 1	1100 Electronic Communication	1110 Security Systems 1	1130 Robotics 1	2010 Electro-assembly 2	2020 Electrical Servicing	2030 Branch Circuit Wiring	2050 Electronic Power Supply 2	2060 Digital Technology 2	2070 Computer Technology	2080 Control Systems 2	2090 Analog Communication 2	2100 Radio Communication	2110 Security Systems 2	2120 Electro-optics	2130 Magnetic Control Devices	2140 Robotics 2	2150 Electronic Controls	3010 Electro-assembly 3	3020 Electronic Servicing	3030 Power Systems & Services	3040 Generation/Transformation	3060 Digital Technology 3	3070 Digital Applications	3080 Microprocessor	3090 Microprocessor Interface	3100 Analog Communication 3	3110 Amplifiers	3130 Data/Telemetry Systems	3140 Motors	3150 Robotics 3	3160 Control Applications
LEVEL				1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
THEME				A	B	B	C	C	D	D	D	E	A	A	B	B	C	C	C	D	D	D	D	E	E	E	A	A	B	B	C	C	C	C	D	D	D	E	E	E
1994 Canadian Electrical Code, Part I: Handbook	p	S	J/S								X			X	X													X										X		
Auto Electricity & Electronics Technology							X	X									X		X												X									
Text & Workbook	p	S	J/S																																					
Instructor's Guide	p	T	J/S																																					
Basic Electronics	p	S	J/S																																					
Book A. Introducing Electronics	p	S	J/S	X	X	X	X	X	X	X			X							X	X																			
Book B. Resistors, Capacitors	p	S	J/S					X	X	X						X				X	X																			
Book C. Diodes and Transistors	p	S	J/S						X	X						X			X	X	X																			
Book D. Analog Systems	p	S	J/S						X								X		X	X	X																			
Book E. Digital Systems	p	S	J/S				X										X																							
Basic Wiring for Canada	p	S	S								X				X							X																		
Build Your Own Home Security System	p	S	J/S								X											X																		
Canadian Electrical Code Handbook, 1994	p	S	S	X	X						X				X									X		X				X								X	X	
Communication Electronics (2nd Ed.)																					X															X				
Text & Activities Manual	p	S	S																																					
Instructor's Resource Guide	p	T	S																																					
Computers Simplified (4th Ed.)	p	S	S											X				X															X							
Digital Electronics (4th Ed.)							X										X	X	X												X	X	X	X						
Text	p	B	J/S																																					
Activities Manual	p	S	J/S																																					
Instructor's Resource Guide	p	T	J/S																																					

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	Format	*Status*	*Junior/Senior High*	Electro-assembly 1	Conversion & Distribution	Electronic Power Supply 1	Digital Technology 1	Control Systems 1	Analog Communication 1	Electronic Communication	Security Systems 1	Robotics 1
LEVEL				1	1	1	1	1	1	1	1	1
THEME				A	B	B	C	C	D	D	D	E
Module Number				1010	1030	1050	1060	1080	1090	1100	1110	1130
Electric Circuits and Machines (7^{th} Ed.)												
Text	*p*	S	S									
Instructor's Guide	*p*	T	S									
Electrical Power, Motors, Control, Gen, Transformers												
Text & Workbook	*p*	S	S									
Instructor's Guide & Answer Key	*p*	T	S									
Electricity 1: Devices, Circuits, and Materials (6^{th} Ed)	*p*	S	J/S		X							
Electricity 2: Devices, Circuits, and Materials (6^{th} Ed)	*p*	S	J/S		X							
Electricity 3: Power Generation and Delivery (6^{th} Ed)	*p*	S	J/S		X							
Electricity 4: AC/DC Motors, Controls and Maintenance (6^{th} Ed)	*p*	S	J/S		X							
Electronic Projects to Control Your Home Environment (6^{th} Ed)	*p*	S	J/S	X								
Electro-Optics												
Text & Workbook	*p*	S	S									
Instructor's Guide	*p*	T	S									

	Electro-assembly 2	Electrical Servicing	Branch Circuit Wiring	Electronic Power Supply 2	Digital Technology 2	Computer Technology	Control Systems 2	Analog Communication 2	Radio Communication	Security Systems 2	Electro-optics	Magnetic Control Devices	Robotics 2	Electronic Controls
LEVEL	2	2	2	2	2	2	2	2	2	2	2	2	2	2
THEME	A	A	B	B	C	C	C	D	D	D	D	E	E	E
Module Number	2010	2020	2030	2050	2060	2070	2080	2090	2100	2110	2120	2130	2140	2150
Electric Circuits and Machines (7^{th} Ed.)							X					X		
Text														
Instructor's Guide														
Electrical Power, Motors, Control, Gen, Transformers												X		X
Text & Workbook														
Instructor's Guide & Answer Key														
Electricity 1: Devices, Circuits, and Materials (6^{th} Ed)			X									X		
Electricity 2: Devices, Circuits, and Materials (6^{th} Ed)			X									X		
Electricity 3: Power Generation and Delivery (6^{th} Ed)			X									X		
Electricity 4: AC/DC Motors, Controls and Maintenance (6^{th} Ed)			X									X		
Electronic Projects to Control Your Home Environment (6^{th} Ed)	X													
Electro-Optics											X			
Text & Workbook														
Instructor's Guide														

	Electro-assembly 3	Electronic Servicing	Power Systems & Services	Generation/Transformation	Digital Technology 3	Digital Applications	Microprocessor	Microprocessor Interface	Analog Communication 3	Amplifiers	Data/Telemetry Systems	Motors	Robotics 3	Control Applications
LEVEL	3	3	3	3	3	3	3	3	3	3	3	3	3	3
THEME	A	A	B	B	C	C	C	C	D	D	D	E	E	E
Module Number	3010	3020	3030	3040	3060	3070	3080	3090	3100	3110	3130	3140	3150	3160
Electric Circuits and Machines (7^{th} Ed.)			X	X								X		
Text														
Instructor's Guide														
Electrical Power, Motors, Control, Gen, Transformers			X	X							X			
Text & Workbook														
Instructor's Guide & Answer Key														
Electricity 1: Devices, Circuits, and Materials (6^{th} Ed)			X	X								X		
Electricity 2: Devices, Circuits, and Materials (6^{th} Ed)			X	X								X		
Electricity 3: Power Generation and Delivery (6^{th} Ed)			X	X								X		
Electricity 4: AC/DC Motors, Controls and Maintenance (6^{th} Ed)			X	X								X		
Electronic Projects to Control Your Home Environment (6^{th} Ed)	X													
Electro-Optics														
Text & Workbook														
Instructor's Guide														

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LEVEL				1	1	1	1	1	1	1	1	1
THEME				A	B	B	C	C	D	D	D	E
	Format	*Status*	*Junior/Senior High*	Electro-assembly 1	Conversion & Distribution	Electronic Power Supply 1	Digital Technology 1	Control Systems 1	Analog Communication 1	Electronic Communication	Security Systems 1	Robotics 1
Module Number				1010	1030	1050	1060	1080	1090	1100	1110	1130
Electronic Fabrication (2nd Ed.)	*p*	B	S	X								
Electronic Power Control						X						
Text	*p*	S	J/S									
Instructor's Guide	*p*	T	J/S									
Electronic Principles and Applications (4th						X			X			
Text & Activities Manual	*p*	S	J/S									
Instructor's Resource Guide & Answer Key	*p*	T	J/S									
Electronic Troubleshooting (2nd)												
Text	*p*	S	S									
Instructor's Answer Key	*p*	T	S									
Electronics for Industrial Electricians							X	X				
Text	*p*	B	S									
Instructor's Guide	*p*	T	S									
Electronics GCSE Technology	*p*	S	J/S	X				X				
Electronics' Workbench (V 3.0) (Windows)	*s*	B	J/S			X	X	X	X	X	X	
150 Circuit (V 3.0)	*s*	S	J/S									
Practical Teaching Ideas (V 3.0)	*s*	S	J/S									
Elementary Electronics	*p*	S	J/S			X	X	X				
Essentials of Electronics: A Survey						X	X	X				
Text	*p*	B	J/S									
Activity Manual	*p*	S	J/S									
Instructor's Resource Guide	*p*	T	J/S									

LEVEL				2	2	2	2	2	2	2	2	2	2	2	2	2	2
THEME				A	A	B	B	C	C	C	D	D	D	D	E	E	E
	Format	*Status*	*Junior/Senior High*	Electro-assembly 2	Electrical Servicing	Branch Circuit Wiring	Electronic Power Supply 2	Digital Technology 2	Computer Technology	Control Systems 2	Analog Communication 2	Radio Communication	Security Systems 2	Electro-optics	Magnetic Control Devices	Robotics 2	Electronic Controls
Module Number				2010	2020	2030	2050	2060	2070	2080	2090	2100	2110	2120	2130	2140	2150
Electronic Fabrication (2nd Ed.)	*p*	B	S	X													
Electronic Power Control							X			X	X						
Text	*p*	S	J/S														
Instructor's Guide	*p*	T	J/S														
Electronic Principles and Applications (4th									X	X							
Text & Activities Manual	*p*	S	J/S														
Instructor's Resource Guide & Answer Key	*p*	T	J/S														
Electronic Troubleshooting (2nd)																	
Text	*p*	S	S														
Instructor's Answer Key	*p*	T	S														
Electronics for Industrial Electricians								X		X							
Text	*p*	B	S														
Instructor's Guide	*p*	T	S														
Electronics GCSE Technology	*p*	S	J/S	X				X			X						
Electronics' Workbench (V 3.0) (Windows)	*s*	B	J/S				X	X	X	X	X	X	X	X	X	X	X
150 Circuit (V 3.0)	*s*	S	J/S														
Practical Teaching Ideas (V 3.0)	*s*	S	J/S														
Elementary Electronics	*p*	S	J/S														
Essentials of Electronics: A Survey							X	X		X	X		X		X	X	
Text	*p*	B	J/S														
Activity Manual	*p*	S	J/S														
Instructor's Resource Guide	*p*	T	J/S														

LEVEL				3	3	3	3	3	3	3	3	3	3	3	3	3	3
THEME				A	A	B	B	C	C	C	C	D	D	D	E	E	E
	Format	*Status*	*Junior/Senior High*	Electro-assembly 3	Electronic Servicing	Power Systems & Services	Generation/Transformation	Digital Technology 3	Digital Applications	Microprocessor	Microprocessor Interface	Analog Communication 3	Amplifiers	Data/Telemetry Systems	Motors	Robotics 3	Control Applications
Module Number				3010	3020	3030	3040	3060	3070	3080	3090	3100	3110	3130	3140	3150	3160
Electronic Fabrication (2nd Ed.)	*p*	B	S	X													
Electronic Power Control																	
Text	*p*	S	J/S														
Instructor's Guide	*p*	T	J/S														
Electronic Principles and Applications (4th																	
Text & Activities Manual	*p*	S	J/S														
Instructor's Resource Guide & Answer Key	*p*	T	J/S														
Electronic Troubleshooting (2nd)				X	X												
Text	*p*	S	S														
Instructor's Answer Key	*p*	T	S														
Electronics for Industrial Electricians																X	
Text	*p*	B	S														
Instructor's Guide	*p*	T	S														
Electronics GCSE Technology	*p*	S	J/S														
Electronics' Workbench (V 3.0) (Windows)	*s*	B	J/S					X	X	X	X	X		X			X
150 Circuit (V 3.0)	*s*	S	J/S														
Practical Teaching Ideas (V 3.0)	*s*	S	J/S														
Elementary Electronics	*p*	S	J/S														
Essentials of Electronics: A Survey												X					
Text	*p*	B	J/S														
Activity Manual	*p*	S	J/S														
Instructor's Resource Guide	*p*	T	J/S														

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	Format	*Status*	*Junior/Senior High*	Electro-assembly 1	Conversion & Distribution	Electronic Power Supply 1	Digital Technology 1	Control Systems 1	Analog Communication 1	Electronic Communication	Security Systems 1	Robotics 1	Electro-assembly 2	Electrical Servicing	Branch Circuit Wiring	Electronic Power Supply 2	Digital Technology 2	Computer Technology	Control Systems 2	Analog Communication 2	Radio Communication	Security Systems 2	Electro-optics	Magnetic Control Devices	Robotics 2	Electronic Controls
LEVEL				1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
THEME				A	B	B	C	C	D	D	D	E	A	A	B	B	C	C	C	D	D	D	D	E	E	E
Module Number				1010	1030	1050	1060	1080	1090	1100	1110	1130	2010	2020	2030	2050	2060	2070	2080	2090	2100	2110	2120	2130	2140	2150
Foundations of Electronics (2nd Ed)				X		X	X						X				X									
Text & Laboratory Projects	*p*	S	J/S																							
Instructor's Guide; Flash Cards	*p*	T	J/S																							
Testbank	*s*	T	J/S																							
Industrial Electronics								X										X	X					X		X
Text & Activity Manual	*p*	S	S																							
Instructor's Resource Guide	*p*	T	S																							
Laser Technology																							X			
Text & Workbook	*p*	S	S																							
Instructor's Guide	*p*	T	S																							
Making Printed Circuit Boards	*p*	S	J/S	X									X													
Mica Soft: Electronics & Microelectronics Tutor (DOS Version)	*s*	B	S	X			X		X	X			X				X		X	X	X	X	X			X
Micro Processors: Principles and Applications																		X								
Text & Activities Manual	*p*	S	S																							
Mobile Robots: Inspiration to Implementation	*p*	S	S									X													X	
Modern Electronic Communication (5th Ed)																										
Text & Lab Manual	*p*	S	S																	X	X		X			
Instructor's Solutions Manual	*p*	T	S																							
Transparency Masters	*p*	T	S																							

	Electro-assembly 3	Electronic Servicing	Power Systems & Services	Generation/Transformation	Digital Technology 3	Digital Applications	Microprocessor	Microprocessor Interface	Analog Communication 3	Amplifiers	Data/Telemetry Systems	Motors	Robotics 3	Control Applications
LEVEL	3	3	3	3	3	3	3	3	3	3	3	3	3	3
THEME	A	A	B	B	C	C	C	C	D	D	D	E	E	E
Module Number	3010	3020	3030	3040	3060	3070	3080	3090	3100	3110	3130	3140	3150	3160
Foundations of Electronics (2nd Ed)				X						X				
Text & Laboratory Projects														
Instructor's Guide; Flash Cards														
Testbank														
Industrial Electronics											X		X	
Text & Activity Manual														
Instructor's Resource Guide														
Laser Technology														
Text & Workbook														
Instructor's Guide														
Making Printed Circuit Boards	X													
Mica Soft: Electronics & Microelectronics Tutor (DOS Version)	X				X			X	X		X		X	
Micro Processors: Principles and Applications							X	X						
Text & Activities Manual														
Mobile Robots: Inspiration to Implementation												X		
Modern Electronic Communication (5th Ed)														
Text & Lab Manual									X	X	X			
Instructor's Solutions Manual														
Transparency Masters														

ELECTRO-TECHNOLOGIES RESOURCES

THEME CODE:
A. Fabrications & Service Principles
B. Power Systems
C. Computer Logic Systems
D. Communication Systems
E. Robotic and Control Systems

FORMAT CODE:
p - Print
v - Video
s - Software

STATUS CODE:
B - Basic
S - Support
T - Teaching

LEVEL CODE:
1 - Introductory
2 - Intermediate
3 - Advanced

JR/SR HIGH CODE:
J - Junior High
S - Senior High

	Format	*Status*	*Junior/Senior High*	Electro-assembly 1	Conversion & Distribution	Electronic Power Supply 1	Digital Technology 1	Control Systems 1	Analog Communication 1	Electronic Communication	Security Systems 1	Robotics 1
LEVEL				1	1	1	1	1	1	1	1	1
THEME				A	B	B	C	C	D	D	D	E
Module Number				1010	1030	1050	1060	1080	1090	1100	1110	1130
Practical VCR Repair	*p*	S	J/S	X						X		
Programmable Logic Controllers												
Text	*p*	S	S									
Workbook/Activity Manual	*p*	S	S									
Instructor's Guide	*p*	T	S									
Quality Hand Soldering and Circuit Board	*p*	S	J/S	X		X	X	X	X	X	X	X
Robot Builders Bonanza, The: 99 Inexpensive Robotic Projects	*p*	S	J/S									X
Robotics & Automated Systems							X	X				X
Text	*p*	S	J/S									
Instructor's Manual & Key	*p*	T	J/S									
Technician's Guide to Fibre Optics										X		
Text	*p*	S	J/S									
Instructor's Guide	*p*	T	J/S									
Today's Electrician: Classroom Manual for Automotive Computer Systems							X	X				
Classroom Manual	*p*	S	J/S									
Shop Manual	*p*	T	J/S									

	Electro-assembly 2	Electrical Servicing	Branch Circuit Wiring	Electronic Power Supply 2	Digital Technology 2	Computer Technology	Control Systems 2	Analog Communication 2	Radio Communication	Security Systems 2	Electro-optics	Magnetic Control Devices	Robotics 2	Electronic Controls
LEVEL	2	2	2	2	2	2	2	2	2	2	2	2	2	2
THEME	A	A	B	B	C	C	C	D	D	D	D	E	E	E
Module Number	2010	2020	2030	2050	2060	2070	2080	2090	2100	2110	2120	2130	2140	2150
Practical VCR Repair		X												
Programmable Logic Controllers					X									X
Text														
Workbook/Activity Manual														
Instructor's Guide														
Quality Hand Soldering and Circuit Board	X	X		X	X		X	X	X	X			X	
Robot Builders Bonanza, The: 99 Inexpensive Robotic Projects					X		X						X	
Robotics & Automated Systems					X		X					X	X	X
Text														
Instructor's Manual & Key														
Technician's Guide to Fibre Optics											X			
Text														
Instructor's Guide														
Today's Electrician: Classroom Manual for Automotive Computer Systems					X	X	X							
Classroom Manual														
Shop Manual														

	Electro-assembly 3	Electronic Servicing	Power Systems & Services	Generation/Transformation	Digital Technology 3	Digital Applications	Microprocessor	Microprocessor Interface	Analog Communication 3	Amplifiers	Data/Telemetry Systems	Motors	Robotics 3	Control Applications
LEVEL	3	3	3	3	3	3	3	3	3	3	3	3	3	3
THEME	A	A	B	B	C	C	C	C	D	D	D	E	E	E
Module Number	3010	3020	3030	3040	3060	3070	3080	3090	3100	3110	3130	3140	3150	3160
Practical VCR Repair		X												
Programmable Logic Controllers														X
Text														
Workbook/Activity Manual														
Instructor's Guide														
Quality Hand Soldering and Circuit Board														
Robot Builders Bonanza, The: 99 Inexpensive Robotic Projects														
Robotics & Automated Systems							X	X				X	X	X
Text														
Instructor's Manual & Key														
Technician's Guide to Fibre Optics														
Text														
Instructor's Guide														
Today's Electrician: Classroom Manual for Automotive Computer Systems							X	X						
Classroom Manual														
Shop Manual														

ELECTRO-TECHNOLOGIES RESOURCES

THEME CODE:
A. Fabrications & Service Principles
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STATUS CODE:
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T - Teaching

LEVEL CODE:
1 - Introductory
2 - Intermediate
3 - Advanced

JR/SR HIGH CODE:
J - Junior High
S - Senior High

	Format	*Status*	*Junior/Senior High*	Electro-assembly 1	Conversion & Distribution	Electronic Power Supply 1	Digital Technology 1	Control Systems 1	Analog Communication 1	Electronic Communication	Security Systems 1	Robotics 1
LEVEL				1	1	1	1	1	1	1	1	1
THEME				A	B	B	C	C	D	D	D	E
Module Number				1010	1030	1050	1060	1080	1090	1100	1110	1130
Tron.ix Basic Concepts & Components	*p*	S	J/S					X				
Troubleshooting & Repairing PC Drives & Memory Systems	*p*	S	S									
Troubleshooting and Repairing Computer Monitors	*p*	S	S									
Troubleshooting and Repairing Personal Computers												
Text	*p*	S	S									
Instructor's Guide	*p*	T	S									
Troubleshooting Electric Motors												
Text	*p*	S	S									
Instructor's Guide	*p*	T	S									
What's New in 1994: Changes to the CE Code Part I	*p*	S	J/S								X	

	Electro-assembly 2	Electrical Servicing	Branch Circuit Wiring	Electronic Power Supply 2	Digital Technology 2	Computer Technology	Control Systems 2	Analog Communication 2	Radio Communication	Security Systems 2	Electro-optics	Magnetic Control Devices	Robotics 2	Electronic Controls
LEVEL	2	2	2	2	2	2	2	2	2	2	2	2	2	2
THEME	A	A	B	B	C	C	C	D	D	D	D	E	E	E
Module Number	2010	2020	2030	2050	2060	2070	2080	2090	2100	2110	2120	2130	2140	2150
Tron.ix Basic Concepts & Components							X							
Troubleshooting & Repairing PC Drives & Memory Systems		X				X								
Troubleshooting and Repairing Computer Monitors		X												
Troubleshooting and Repairing Personal Computers					X	X								
Text														
Instructor's Guide														
Troubleshooting Electric Motors														
Text														
Instructor's Guide														
What's New in 1994: Changes to the CE Code Part I		X	X											

	Electro-assembly 3	Electronic Servicing	Power Systems & Services	Generation/Transformation	Digital Technology 3	Digital Applications	Microprocessor	Microprocessor Interface	Analog Communication 3	Amplifiers	Data/Telemetry Systems	Motors	Robotics 3	Control Applications
LEVEL	3	3	3	3	3	3	3	3	3	3	3	3	3	3
THEME	A	A	B	B	C	C	C	C	D	D	D	E	E	E
Module Number	3010	3020	3030	3040	3060	3070	3080	3090	3100	3110	3130	3140	3150	3160
Tron.ix Basic Concepts & Components									X					
Troubleshooting & Repairing PC Drives & Memory Systems		X				X								
Troubleshooting and Repairing Computer Monitors		X												
Troubleshooting and Repairing Personal Computers		X												
Text														
Instructor's Guide														
Troubleshooting Electric Motors		X	X									X		
Text														
Instructor's Guide														
What's New in 1994: Changes to the CE Code Part I		X										X		

OTHER RESOURCES

These titles are provided as a service only to assist local jurisdictions to identify resources that contain potentially useful ideas for teachers. Alberta Education has done a preliminary review of the resources. However, the responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Distributor Code	Other Resources	Levels/Module No.		
		1	2	3
AECD	*Apprenticeship Training: Communication Electrician Program.* Edmonton, AB: Alberta Advanced Education and Career Development, Apprenticeship and Industry Training. Curriculum outline. Describes the parameters/course requirements for apprenticeship in the Communication Electrician trade.	1090 1100	2090 2100 2120	
AECD	*Apprenticeship Training: Electrician Program.* Edmonton, AB: Alberta Advanced Education and Career Development, Apprenticeship and Industry Training. Curriculum Outline. Describes the parameters/course requirements for apprenticeship in the Electrical trade.		2030	3030 3040 3140
AECD	*Apprenticeship Training: Electronic Technician.* Edmonton, AB: Alberta Advanced Education and Career Development, Apprenticeship and Industry Training. Curriculum Outline. Describes the parameters/course requirements for apprenticeship in the Electronic Technician trade.	1060 1080	2060 2070 2080	3060 3070 3080
AECD	*Apprenticeship Training: Power Lineman Program.* Edmonton, AB: Alberta Advanced Education and Career Development, Apprenticeship and Industry Training. Curriculum Outline. Describes the parameters/course requirements for apprenticeship in the Power Lineman trade.	1030	2030	3030
AECD	*Apprenticeship Training: Power System Electrician Program.* Edmonton, AB: Alberta Advanced Education and Career Development, Apprenticeship and Industry Training. Curriculum Outline. Describes the parameters/course requirements for apprenticeship in the Power System Electrician trade.	1030 1050	2030 2050	3030 3040 3140

Other Resources (continued)

Distributor Code	Other Resources	Levels/Module No.		
		1	2	3
ACC	*Electrical Theory Series.* Edmonton, AB: ACCESS: The Education Station. Video. • *Practical Considerations* • *Ohm's Law* • *Power Considerations In Resistive Circuits* • *Inductance* • *Factors Affecting Inductance* • *Induction - The Process* • *Self-Induction* • *Inductive Time Constants* • *Inductive Reactance* • *Phase Relationship in Inductive Circuits* • *Characteristics of a Capacitor* • *Factors Affecting Capacitance* • *R.C. Time Constants* • *Capacitive Reactance* • *Phase Relationship in Capacitive Circuits* • *Current in R, I and C Circuits.*	all	all	all
ACC	*Measure Up Series.* Edmonton, AB: ACCESS: The Education Station. Video. • *The Ohmmeter* • *The Voltmeter* • *The Ammeter* • *The Oscilloscope I & II.*	all	all	all
MHR	*Technical Reference Books.* Blue Ridge Summit, PA, USA. Tab Books. Division of McGraw-Hill Ryerson Ltd., • *Experiments with EPROMS* • *Incredible Audio and Video Projects You Can Build* • *The Laser Cookbook* • *Capture the Spirit of Invention* • *Video, Stereo and Opto-Electronics* • *How To Test Almost Anything Electronic.*	1090 1100 1120	2010 2060 2090	3010 3060 3090
PHGP	*Technical Reference Books.* SAMS, A Division of Prentice Hall Computer Publishing. • *Getting Started in Electronics* • *Principles of Digital Audio* • *Understanding Solid State Electronics* • *Understanding Telephone Electronics* • *Video Scrambling and Descrambling for Satellite and Cable TV.*	1010 1060 1080	2060 2070 2080	3060 3070 3090 3130

Other Resources (continued)

Distributor Code	Other Resources	Levels/Module No.		
		1	2	3
ESI	*UCANDO Electronic Training Videos Series.* UCANDO VCR. Educational Products Company/Circuit Test Electronics. ElectroSonic Inc., 1992-94. Videos with Student Workbooks. • *Introduction to VCR Repair* • *VCR Maintenance and Repair.*			3020
ESI	*UCANDO Electronic Training Videos Series.* UCANDO VCR. Educational Products Company/Circuit Test Electronics. ElectroSonic Inc., 1992-94. Videos with Student Workbooks. • *Part 1: Direct Current* • *Part 2: Alternating Current* • *Part 3: Semiconductors* • *Part 4: Power Supplies* • *Part 5: Amplifiers* • *Part 6: Oscillators.*	all	all	all
ESI	*UCANDO Electronic Training Videos Series.* UCANDO VCR. Educational Products Company/Circuit Test Electronics. ElectroSonic Inc., 1992-94. Videos with Student Workbooks. • *Digital 1, 2, 3, 4, 5, 6.*	1060 1080	2060 2070 2080	3060 3070 3080 3090
ESI	*UCANDO Electronic Training Videos Series.* UCANDO VCR. Educational Products Company/Circuit Test Electronics. ElectroSonic Inc., 1992-94. Videos with Student Workbooks. • *AM Radio* • *Part 1 & 2: FM Radio* • *Part 1 & 2: TV.*	1090 1100 1110	2090 2100 2110 2120	3100 3110 3130
ESI	*UCANDO Electronic Training Videos Series.* UCANDO VCR. Educational Products Company/Circuit Test Electronics. ElectroSonic Inc., 1992-94. Videos with Student Workbooks. • Understanding Fiber Optics.		2120	

ADDITIONAL SOURCES

Available to Career and Technology Studies (CTS) teachers, locally and provincially, are many sources of information that can be used to enhance CTS. These sources are available through the community (e.g., libraries, boards, committees, clubs, associations) and through government agencies, resource centres and organizations. Some sources, e.g., government departments, undergo frequent name and/or telephone number changes. Please consult your telephone directory or an appropriate government directory.

The following is a partial list of sources to consider:

TEACHER–LIBRARIANS

Planned and purposeful use of library resources helps students grow in their ability to gather, process and share information. Research activities require access to an adequate quantity and variety of appropriate, up-to-date print and nonprint resources from the school library, other libraries, the community and additional sources. Some techniques to consider are:

- planning together
- establishing specific objectives
- integrating research skills into planning.

Cooperation between the teacher-librarian and the subject area teacher in the development of effectively planned resource-based research activities ensures that students are taught the research skills as well as the subject content. Also see *Focus on Research: A Guide to Developing Student's Research Skills* referenced in the Alberta Education resources section.

ALBERTA EDUCATION SOURCES

Alberta Government telephone numbers can be reached toll free from outside Edmonton by dialing 310–0000.

The following monographs are available for purchase from the Learning Resources Distributing Centre. Refer to the Distributor Directory at the end of this section for address, telephone, fax and Internet address.

Please consult the "Support Documents" section or the "Legal, Service and Information Publications" section in the LRDC *Buyers Guide* for ordering information and costs.

Developmental Framework Documents

- *The Emerging Student: Relationships Among the Cognitive, Social and Physical Domains of Development,* 1991 (Stock No. 161555)

  This document examines the child, or student, as a productive learner, integrating all the domains of development: cognitive, social and physical. It emphasizes the need for providing balanced curriculum and instruction.

- *Students' Interactions Developmental Framework: The Social Sphere,* 1988 (Stock No. 161399)

  This document examines children's perceptual, structural and motor development and how such physical development affects certain learning processes.

- *Students' Physical Growth: Developmental Framework Physical Dimension*, 1988 (Stock No. 161414)

  This document examines children's normal physical growth in three areas: perceptual, structural and motor development. In none of these areas is the child's growth in a single continuous curve throughout the first two decades of life. Physical growth is characterized by periods of rapid growth and periods of slower growth. Consequently, differences and changes in growth patterns may affect the timing of certain learning processes.

Other

- *Focus on Research: A Guide to Developing Students' Research Skills*, 1990 (Stock No. 161802)

  This document outlines a resource-based research model that helps students manage information effectively and efficiently, and gain skills that are transferable to school and work situations. This model provides a developmental approach to teaching students how to do research.

- *Teaching Thinking: Enhancing Learning*, 1990 (Stock No. 161521)

  Principles and guidelines for cultivating thinking, ECS to Grade 12, have been developed in this resource. It offers a definition of thinking, describes nine basic principles on which the suggested practices are based, and discusses possible procedures for implementation in schools and classrooms.

ACCESS: The Education Station

ACCESS: The Education Station offers a variety of resources and services to teachers. For a nominal dubbing and tape fee, teachers may have ACCESS: The Education Station audio and video library tapes copied. ACCESS: The Education Station publishes listings of audio and video cassettes as well as a comprehensive programming schedule.

Of particular interest are the CTS videos, which are available with utilization guides. The guides outline key points in each video and suggest questions for discussion, classroom projects and other activities. Video topics are listed in the Support Learning Resources section of this guide. The videos and accompanying support material can be obtained from ACCESS: The Education Station. Refer to the Distributor Directory at the end of this section for address, telephone, fax and Internet address.

GOVERNMENT SOURCES

National Film Board of Canada (NFB)

The NFB has numerous films and videotapes that may be suitable for Career and Technology Studies strands. For a list of NFB films and videotapes indexed by title, subject and director, or for purchase of NFB films and videotapes, call 1–800–267–7710 (toll free) or Internet address: http://www.nfb.ca

ACCESS: The Education Station and some school boards have acquired duplication rights to some NFB videotapes. Please contact ACCESS: The Education Station or consult the relevant catalogues in your school or school district.

The Edmonton Public Library and the Calgary Public Library have a selection of NFB films and videotapes that can be borrowed free of charge with a Public Library borrower's card. For further information, contact:

Edmonton Public Library
Telephone: 403–496–7000

Calgary Public Library
Telephone: 403–260–2650

For further information contact:

Statistics Canada
Regional Office
8th Floor, Park Square
10001 Bellamy Hill
Edmonton, AB T5J 3B6
Telephone: 403–495–3027
Fax: 403–495–5318
Internet address: http://www.statcan.ca

Statistics Canada produces periodicals, reports, and an annual year book.

Resource Centres

Urban Resource Centres

Instructional Services
Elk Island Public Schools
2001 Sherwood Drive
Sherwood Park, AB T8A 3W7
Telephone: 403–464–8235
Fax: 403–464-8033
Internet Address: http://ei.educ.ab.ca

Learning Resources Centre
Red Deer Public School Board
4747 – 53 Street
Red Deer, AB T4N 2E6
Telephone: 403–343–8896
Fax: 403–347–8190

Instructional Materials Centre
Calgary Separate School Board
6220 Lakeview Drive SW
Calgary, AB T3E 5T1
Telephone: 403–298–1679
Fax: 403–249–3054

School, Student, Parent Services Unit
Program and Professional Support Services Sub Unit
Calgary Board of Education
3610 – 9 Street SE
Calgary, AB T2G 3C5
Telephone: 403–294–8542
Fax: 403–287–9739

After July 1, 1997, please contact the School, Student, Parent Services Unit regarding the relocation of the Loan Pool Resource Unit.

Learning Resources
Edmonton Public School Board
Centre for Education
One Kingsway Avenue
Edmonton, AB T5H 4G9
Telephone: 403–429–8387
Fax: 403–429–0625

Instructional Materials Centre
Medicine Hat School District No. 76
601 – 1 Avenue SW
Medicine Hat, AB T1A 4Y7
Telephone: 403–528–6719
Fax: 403–529–5339

Resource Centre
Edmonton Catholic Schools
St. Anthony's Teacher Centre
10425 – 84 Avenue
Edmonton, AB T6E 2H3
Telephone: 403–439–7356
Fax: 403–433–0181

Instructional Media Centre
Northern Lights School Division No. 69
Bonnyville Centralized High School
4908 – 49 Avenue
Bonnyville, AB T9N 2J7
Telephone: 403–826–3366
Fax: 403–826–2959

Regional Resource Centres

Zone 1

Zone One Regional Resource Centre
P.O. Box 6536
10020 – 101 Street
Peace River, AB T8S 1S3
Telephone: 403–624–3187
Fax: 403–624–5941

Zone 2/3

Central Alberta Media Services (CAMS)
182 Sioux Road
Sherwood Park, AB T8A 3X5
Telephone: 403–464–5540
Fax: 403–449–5326

Zone 4

Information and Development Services
Parkland Regional Library
5404 – 56 Avenue
Lacombe, AB T4L 1G1
Telephone: 403–782–3850
Fax: 403–782–4650
Internet Address: http://rtt.ab.ca.rtt/prl/prl.htm

Zone 5

South Central Alberta Resource Centre (SCARC)
Golden Hills Regional Division
435A Hwy 1
Westmount School
Strathmore, AB T0J 3H0
Telephone: 403–934–5028
Fax: 403–934–5125

Zone 6

Southern Alberta Learning Resource Centre (SALRC)
Provincial Government Administration Building
909 Third Avenue North, Room No. 120
Box 845
Lethbridge, AB T1J 3Z8
Telephone: 403–320–7807
Fax: 403–320–7817

OTHER GOVERNMENT SOURCES

Alberta Advanced Education and Career Development
Library
Information and Policy Services
9th Floor Commerce Place
10155 102 Street
Edmonton, AB T5J 4L5
Telephone: 403–422–4752
Fax: 403–427–0793

Catalogue of Career Development Resources "The Career Shop", 1996
The Career Planner
Children Challenge Choice
Entrepreneur: A Big Word for Small Business
Positive Works
"A Model for Excellence", Alberta Apprenticeship System.

Videos on career planning and entrepreneurial topics are available through the library of this department. Call 403–422–4752 for more information. The following videos are representative of the library's holdings:
The Entrepreneur
Get a Job
A Head for Business
The Seven Phases of a Job Interview
"A Model for Excellence", Alberta Apprenticeship System.

Alberta Apprenticeship Program
For more information, contact the Alberta Advanced Education and Career Development office nearest you or call the Alberta Career Information Hotline, 1-800–661–3753 (toll free), Edmonton 403–422–4266.

Alberta Economic Development and Tourism
Technology and Research Branch
9th Floor, Sterling Place
9940 106 Street
Edmonton, AB T5K 2P6
Telephone: 403–422–0561
Fax: 403–422–2091

Alberta Research Council
6815 – 8 Street N. E.
Calgary, Alberta T2E 7H7
Telephone: 403–297–2600
Fax: 403–297–2339

Alberta Environmental Protection
Education Branch
11th Floor, South Petroleum Plaza
9915 – 108 Street
Edmonton, AB T5K 2G8
Telephone: 403–427–6310
Fax: 403–427–2512

(Workshops and presentations can be arranged.)

Alberta Health
Environmental Health Services
Box 1360
14 Floor, 10025 Jasper Avenue
Edmonton, AB T5J 2N3
Telephone: 403–427–2643

Alberta Labour
9940 – 106 Street
Edmonton, AB T5K 2N2
Telephone: 403–427–8848
Fax: 403–427–0999

Offices are also in Calgary, Camrose, Edson, Fort McMurray, Grande Prairie, Lethbridge, Medicine Hat, Red Deer and Vermillion.

Alberta Occupational Health and Safety
Main Floor, Sterling Place
9940 – 106 Street
Edmonton, AB T5K 2N2
Telephone: 403–427–2320; 403–427–3530
Fax: 403–427–5698

Offices are also in Calgary, Camrose, Edson, Fort McMurray, Grande Prairie, Lethbridge, Lloydminster Medicine Hat, Red Deer and Vermilion.

Industry and Science Canada
Consumer Affairs
10225 – 100 Avenue
Edmonton, AB T5J 0A1
Telephone: 403–495–2485
Fax: 403–495–6451

or

Standard Life Tower
400, 639 – 5 Avenue SW
Calgary, AB T2P 0M9
Telephone: 403–292–6183
Fax: 403–292–6175

PROFESSIONAL ASSOCIATIONS

Alberta Teachers' Association
Specialist Council
(Alberta Teachers' Association)
Barnett House
11010 – 142 Street
Edmonton, AB T5N 2R1
Telephone: 403–453–2411
Fax: 403–455–6481

INDUSTRY ORGANIZATIONS

Alberta Society of Engineering Technologist
2100, 10104 – 103 Avenue
Canada Trust Tower
Edmonton, AB T5J 0H8

Association of Professional Engineers, Geologists and Geophysicists of Alberta
15th Floor, Tower One
Scotia Place, 10060 Jasper Avenue
Edmonton, AB T5J 4A2

Canadian Council of Technicians and Technologists
285 McLeod Street, 2nd Floor
Ottawa, ON K2P 1A1

Canadian Society for Electrical Engineering
700, 2050 Mansfield Street
Montreal, PQ H3A 1Z2

Electro Federation of Canada
Suite 210
10 Carlson Court
Rexdale, ON M9W 6L2

Electronic & Appliance Service Industry Association
Suite 360, 918 – 16 Avenue NW
Calgary, AB T2M 0K3

Electronic Industry Association of Alberta
203 Advanced Technology Centre
9650 – 20 Avenue
Edmonton, AB T6N 1G1

Electronic Kits International
178 South State Street
Orem, Utah

Digital Magic Lab Kit
Digiatal Magic Digital Electronics Labs (Software)

International Brotherhood of Electrical Workers Local 1007
11007 – 84 Street
Edmonton, AB T5H 1M9

Simmonds/Cardinal
Box 1200
Edmonton, Alberta T5J 2P4
Telephone: 403–483–6266
Fax: 403–484–8926

Radio Course Kit.

ENVIRONMENTAL FACILITIES

The following is a partial list of facilities that provide hands-on experience for students in aspects of resource management and environmental education. Contact should be made directly with the facility to obtain details of what is offered to school groups or students.

Energeum
(Energy Resources Conservation Board)
640 – 5 Avenue SW
Calgary, AB T2P 3G4
Telephone: 403–297–4293

Environmental Resource Centre
10511 Saskatchewan Drive
Edmonton, AB T6E 4S1
Telephone: 403–433–4808

OTHER AGENCIES

Canadian Foundation for Economic Education
501, 2 St. Clair Avenue West
Toronto, ON M4V 1L5
Telephone: 416–968–2236
Fax: 416–968–0488

Entrepreneurship: A Primer for Canadians (teacher resource)
Labour Market: Teacher's Resource Package (teacher resource)
Money and Youth
Women in the Work Force.

The Conference Board of Canada
255 Smyth Road
Ottawa, ON K1H 8M7
Telephone: 613–526–3280
Fax: 613–526–4857

Economic Forecast: Provincial Outlook (research reports, personalized information services).

FEESA, Environmental Education Society
900, 10150 – 100 Street
Edmonton, AB T5J 0P6
Telephone: 403–421–1497
Fax: 403–425–4506

FEESA offers education training and resource materials focusing on a variety of environmental and educational needs. Programs are developed in partnership with business, industry, government, environmental and education groups.

Junior Achievement of Northern Alberta
22, 10210 – 117 Street
Edmonton, AB T5K 1X6
Telephone: 403–482–7521
Fax: 403–488–5924

Junior Achievement of Southern Alberta
739 – 10 Avenue SW
Calgary, AB T2R 0B3
Telephone: 403–263–2545
Fax: 403–261–6988

Materials are available only where Junior Achievement has identified community business consultants and provided inservice.

DISTRIBUTOR DIRECTORY

The entries in the Distributor Directory are arranged alphabetically by code.

CODE	Distributor/Address	Contact Via
ACC	ACCESS: The Education Station 3270 – 76 Avenue Edmonton, AB T6B 2N9	403–440–7777 Fax: 403–440–8899 1–800–352–8293 http://www.ccinet.ab.ca/access
AECD	Alberta Advanced Education and Career Development 10th Floor, Commerce Place 10155 – 102 Street Edmonton, AB T5H 4L5	403–427–8765
ESI	Electrosonic 222S Heritage Square, 8500 Macleod Trail SE Calgary, AB T2H 0M6	403–255–9550 Fax: 403–255–0449 1–800–56–SONIC
LRDC	Learning Resources Distributing Centre 12360 – 142 Street Edmonton, AB T5L 4X9	403–427–5775 Fax: 403–422–9750 http://ednet.edc.gov.ab.ca/lrdc
MHR	McGraw-Hill Ryerson Ltd. See LRDC *Buyers Guide* for information	

ELECTRO-TECHNOLOGIES

SECTION J: SAMPLE STUDENT LEARNING GUIDES

The following pages provide background information, strategies and a template for developing student learning guides. Also included at the end of this section are several sample student learning guides for Electro-Technologies.

A student learning guide provides information and direction to help students attain the expectations defined in a specified CTS module. It is designed to be used by students under the direction of a teacher.

Many excellent student learning guides (SLGs) are available for use and/or are in the process of being developed. While Alberta Education provides a development template accompanied by some samples, most student learning guide development is being done by individuals and organizations across the province (e.g., school jurisdictions, specialist councils, post-secondary organizations). Refer to the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* (Appendix 11) for further information regarding student learning guide developers and sources.

Note: A student learning guide is not a self-contained learning package (e.g., Distance Learning Module), such as you might receive from the Alberta Distance Learning Centre (ADLC) or Distance Learning Options South (DLOS).

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- Components of a Student Learning Guide J.3
- Strategies for Developing Student Learning Guides J.4

SAMPLE STUDENT LEARNING GUIDE TEMPLATE J.5

SAMPLE STUDENT LEARNING GUIDES
- ELT1010 Electro-assembly 1 ..... J.11
- ELT1130 Robotics 1 ..... J.23

BACKGROUND INFORMATION

A Student Learning Guide (SLG) is a presentation of information and direction that will help students attain the expectations defined in a specified CTS module. It is designed to be used by students under the direction of a teacher. A SLG is not a self-contained learning package such as you might receive from the Alberta Distance Learning Centre (ADLC) or Distance Learning Options South (DLOS).

Each SLG is based on curriculum and assessment standards as defined for a particular CTS module. Curriculum and assessment standards are defined in this document through:

- module and specific learner expectations (Sections D, E and F)
- assessment criteria and conditions (Sections D, E and F)
- assessment tools (Section G).

The SLG is written with the student in mind and makes sense to the student in the context of his or her CTS program. SLGs are designed to guide students through modules under the direction of the teacher. They can be used to guide:

- an entire class
- a small groups of students
- individual students.

In some instances, the Student Learning Guide may also be used as teacher lesson plans. When using SLGs as teacher lesson plans, it should be noted that they tend to be:

- learner-centred (versus teacher-directed)
- activity-based (versus lecture-based)
- resource-based (versus textbook-based).

Components of a Student Learning Guide

The student learning guide format, as developed by Alberta Education, typically has *seven* components as described below.

1. *Why Take This Module?*

   This section provides a brief rationale for the work the student will do, and also establishes a context for learning (i.e., in relation to the strand, a life pursuit, a specific industry, etc.).

2. *What Do You Need To Know Before You Start?*

   In this section, prerequisite knowledge, skills and attitudes considered necessary for success in the module are identified. Prerequisites may include other modules from within the strand or from related CTS strands, as well as generic knowledge and skills (e.g., safety competencies, the ability to measure/write/draw, prior knowledge of basic information relevant to the area of study).

3. *What Will You Know And Be Able To Do When You Finish?*

   This information must parallel and reflect the curriculum and assessment standards as defined for the module. You may find it desirable to rewrite these standards in less formal language for student use.

4. *When Should Your Work Be Done?*

   This section provides a timeline that will guide the student in planning their work. The timeline will need to reflect your program and be specific to the assignments you give your students. You may wish to include a time management chart, a list of all assignments to be completed, and instructions to the student regarding the use of a daily planner (i.e., agenda book) to organize their work.

5. *How Will Your Mark For This Module Be Determined?*

   This section will interpret the assessment criteria and conditions, assessment standards, assessment tools and suggested emphasis as defined for the module within the context of the projects/tasks completed. Accepted grading practices will then be used to determine a percentage grade for the module—a mark not less than 50% for successful completion. (**Note**: A module is "successfully completed" when the student can demonstrate ALL of the exit-level competencies or MLEs defined for the module.)

6. *Which Resources May You Use?*

   Resources considered appropriate for completing the module and learning activities are identified in this section of the guide. The resources may be available through the Learning Resources Distributing Centre (LRDC) and/or through other agencies. Some SLGs may reference a single resource, while others may reference a range of resources. Resources may include those identified in the Learning Resource Guide (Section I) as well as other sources of information considered appropriate.

7. *Activities/Worksheets*

   This section provides student-centred and activity-based projects and assignments that support the module learner expectations. When appropriately aligned with curriculum and assessment standards, successful completion of the projects and assignments will also indicate successful completion of the module.

Strategies for Developing Student Learning Guides

Prior to commencing the development of a student learning guide, teachers are advised to obtain:

- the relevant Guide to Standards and Implementation
- the student learning guide template.

Information communicated to the student in the SLG must parallel and reflect the curriculum and assessment standards as defined for the module. Therefore, critical elements of the Guide to Standards and Implementation that need to be addressed throughout the SLG include:

- module and specific learner expectations
- assessment criteria and conditions
- assessment standards
- assessment tools.

Additional ideas and activities will need to be incorporated into the student learning guide. These can be obtained by:

- reflecting on projects and assignments you have used in delivering programs in the past
- identifying human and physical resources available within the school and community
- networking and exchanging ideas (including SLGs) with other teachers
- reviewing the range of resources (e.g., print, media, software) identified in the Learning Resource Guide (Section I) for a particular module/strand.

Copyright law must also be adhered to when preparing a SLG. Further information and guidelines regarding copyright law can be obtained by referring to the:

- *Copyright Act*
- *Copyright* and the *Can Copy Agreement.*

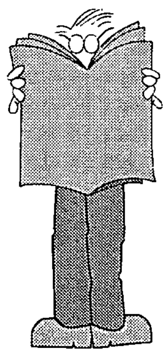
A final task in developing a student learning guide involves validating the level of difficulty/ challenge/rigour established, and making adjustments as considered appropriate.

A template for developing student learning guides, also available on the Internet, is provided in this section (see "Student Learning Guide Template," pages J.5–10). Several sample student learning guides are also provided in this section (see "Sample Student Learning Guides," starting on page J.11.

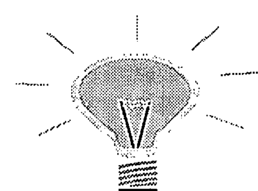
CAREER & TECHNOLOGY STUDIES

SAMPLE STUDENT LEARNING GUIDE TEMPLATE

WHY TAKE THIS MODULE?

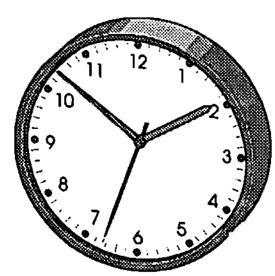


WHAT DO YOU NEED TO KNOW BEFORE YOU START?



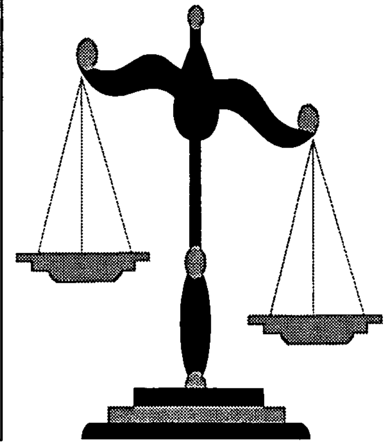
WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

WHEN SHOULD YOUR WORK BE DONE?

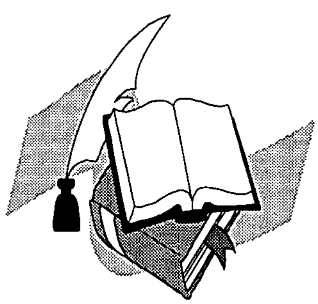


HOW WILL YOUR MARK FOR THIS MODULE BE DETERMINED?

	PERCENTAGE



WHICH RESOURCES MAY YOU USE?



-
-
-
-
-
-

ACTIVITIES/WORKSHEETS

CAREER & TECHNOLOGY STUDIES

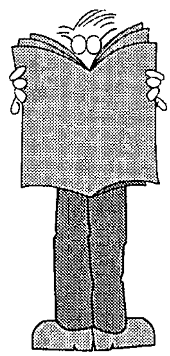
ELECTRO-TECHNOLOGIES

SAMPLE STUDENT LEARNING GUIDE

ELT1010 Electro-assembly 1

ELT1010 Electro-assembly 1

WHY TAKE THIS MODULE?

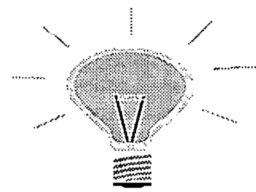


The areas of electricity and electronics offer many job opportunities. Competent electronics technicians will be in demand well into the 21st century. An understanding of basic technology, principles and skill will enable you to learn about many other areas of electronics.

WHAT DO YOU NEED TO KNOW BEFORE YOU START?

There are no prerequisites identified for this module.

However, you should be able to make basic arithmetic calculations and be able to read and follow instructions accurately.



ELT1010 Electro-assembly 1

WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

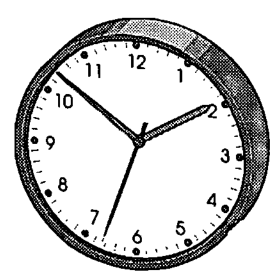
Upon completion of this module you will be able to:

- apply the appropriate fabrication techniques, including proper soldering and component assembly procedures, to construct and test a simple electronic circuit
- apply the appropriate fabrication techniques to construct and test an electromagnetic device
- identify and assemble common electrical/electronic cables and connectors used in power, audio and video connections
- demonstrate established laboratory procedures and safe work practices
- demonstrate basic competencies.

WHEN SHOULD YOUR WORK BE DONE?

Your teacher will give you a timeline for completing tasks and assignments within this module. Usually the work will be completed within 15 classes from the starting date.

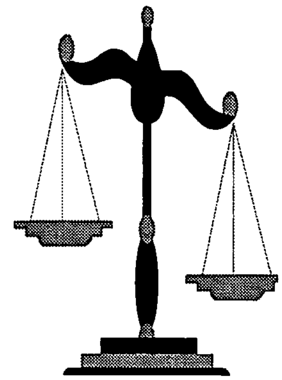
You may also wish to use a time-management planning chart to preplan the work that needs to be done in this module. Plan how you will use your class time as well as extra time needed to complete the assignments in this module.



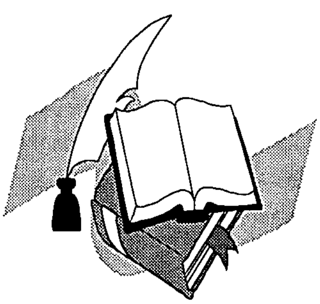
ELT1010 Electro-assembly 1

HOW WILL YOUR MARK FOR THIS MODULE BE DETERMINED?

	EMPHASIS
You must first demonstrate **all** of the competencies required for this module. When you have done this, your mark will be determined as follows:	
• Splicing	10%
• Wire and Cable	10%
• Small Circuit	20%
• Measuring Instruments	10%
• Electromagnetic Devices	20%
• Components	20%
• Troubleshooting	10%



WHICH RESOURCES MAY YOU USE?



- (BE) *Basic Electronics Series* A, B, C, D, E.
- (EL) *Elementary Electronics.*
- (EO) *Essentials of Electronics.*
- (GC) *GCSE Electronics.*
- (QH) *Quality Hand Soldering and Circuit Board Repair.*
- (TE) *Troubleshooting Electrical/Electronic Systems.*
- The attached worksheets.
- John Shore booklet.

ELT1010 Electro-assembly 1

ACTIVITIES/WORKSHEETS

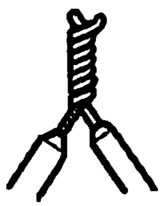
1. Splicing (attached sheets)
   - Watch demo by instructor
   - Read (QH)
2. Wires and Cables (attached sheets)
   - BNC cables
   - Banana plug test leads
   - Alligator clip test leads
   - Telephone connectors
   - RF cables
   - Extension cords
3. Small Circuits (attached sheets)
   - Watch demo by instructor
   - Lamp
   - Single doorbell
   - Double doorbell
   - Multiple doorbells
4. Measuring instruments
   - Read (BE) p. 47A; (EE) Ch. 4; (EL) Ch. 2, pp. 21–23; (EO) Ch. 8, pp. 73–90; (FE) pp. 54–60; (TE) Ch. 4, pp. 73–80–98
   - Read appropriate manuals
   - Measure cells and batteries (attached sheet)
   - Measure resistors (attached sheet)
5. Electromagnetic devices
   - See John Shore booklet
   - Construct an electromagnetic device
   - Demonstrate the operation of an electromagnetic device
6. Component identification and installation
   - Lesson by instructor
   - Watch demo by instructor
   - Solder components onto boards
   - Breadboarding
7. Troubleshooting
   - Repair of small appliances (as available)
     - blow dryer
     - curling iron
     - toaster
     - kettle

WIRE SPLICING PROCEDURE

Materials Needed

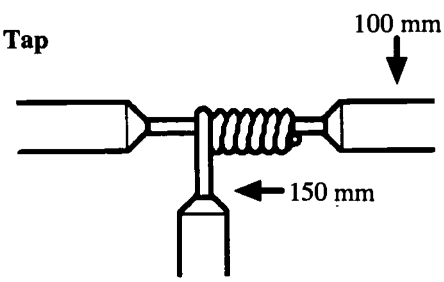
- 10 pieces of 14 gauge solid wire, 100 mm long
- 3 pieces of 14 gauge solid wire, 150 mm long
- 7 pieces of 19 gauge stranded wire, 100 mm long

Pigtail



- Make 3 pigtails
- Use 2 pieces of 100 mm solid wire
- Strip 25 mm of insulation off one end of each wire
- Twist the wires together as shown
- Clip the uneven ends off the wires

Tap

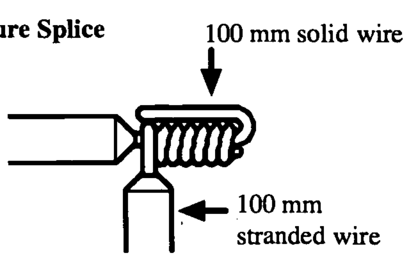


- Make 3 taps
- Use 1 piece of 100 mm solid wire
- Use 1 piece of 150 mm solid wire
- Strip 65–70 mm off the end of the 150 mm wire
- Strip 25 mm out of the middle of the 100 mm wire
- Twist the wires together as shown
- You must have at least 6 complete wraps

Western Union

- Make 3 Western Unions
- Use 2 pieces of 100 mm stranded wire
- Strip 37 mm of insulation off one end of each wire
- Twist the wires together as shown
- Ensure the stranded wire does not splay apart
- You must have at least 3 turns on either side of the cross over

Fixture Splice



- Make 1 fixture splice
- Use 1 piece of 100 mm solid wire
- Use 1 piece of 100 mm stranded wire
- Twist the wires together as shown

Note: Make sure the ends on all splices are wrapped in tight.
Have the instructor check your splices and initial here. ______________

ELT1010 Electro-assembly 1

Soldering

1. We solder connections to increase strength and to make a better connection with lower resistance.

2. Read the MSDS regarding FLUX and SOLDER.
   FLUX must be put on splices before they can be soldered. Use FLUX sparingly. FLUX does three things: it removes oxides (cleans the metal), it breaks down surface tension (allows solder to flow more easily along the wire), and it acts as a catalyst (helps to form a better bond between the solder and the wire).

3. Observe a demonstration of the correct method of soldering by the instructor.

4. The soldering pencil or soldering gun is only a source of heat. **DO NOT** put solder on the tip and try to spread it around on the splice. Use the soldering pencil to heat the splice. Push the solder against the splice. When the splice is hot enough it will melt the solder. The solder will run freely throughout the splice. Take away the solder. Take away the soldering pencil. **LET IT COOL!!**

5. Have the instructor check your soldering and initial here. ______________

Taping

1. One of each type of splice must be taped with electrical tape (except the fixture splice).

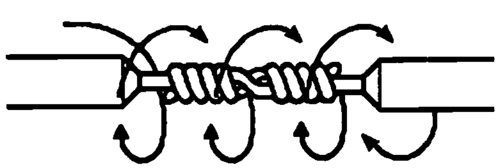
2. Follow the arrows in the diagrams for proper procedure.

3. Pull the tape tight as you wrap it.

4. When finished you should not be able to see any bare wire, all uninsulated wire should have 3 layers of tape on it, and there should not be any openings or gaps in the layers of tape, NO WRINKLES OR FOLDS.

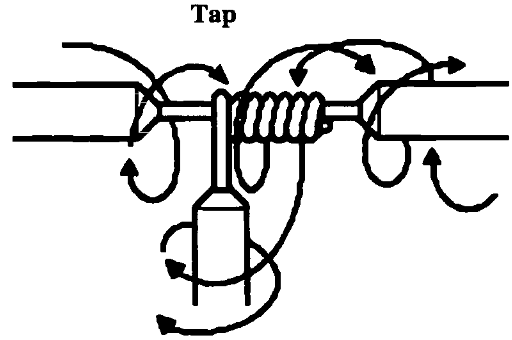
5. Have the instructor check each taping sample after it is taped.

Western Union



Circular pattern around the wire

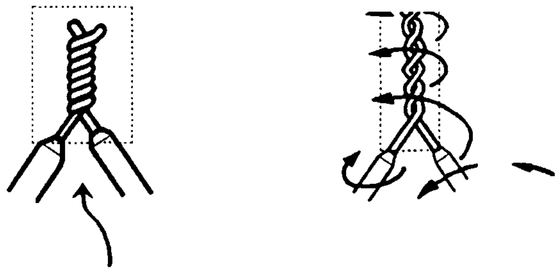
Tap



FOLLOW ARROWS – AND PUT THREE LAYERS OF TAPE OVER THE SPLICED AREA

Instructor's Initials ______________ Instructor's Initials ______________

Pigtail



Instructor's Initials ____________

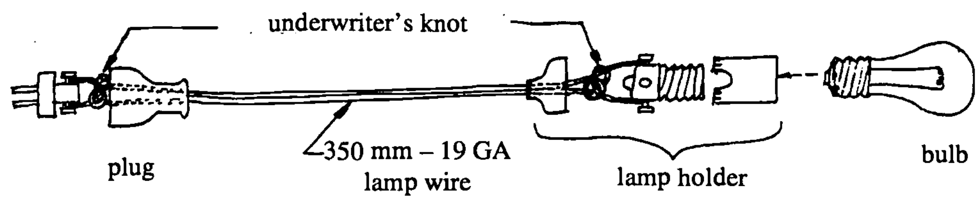
Hand In

Use a minimum length of masking tape to tape all of your splicing samples together, put your name neatly on the tape and hand in all of your splicing work for marking.

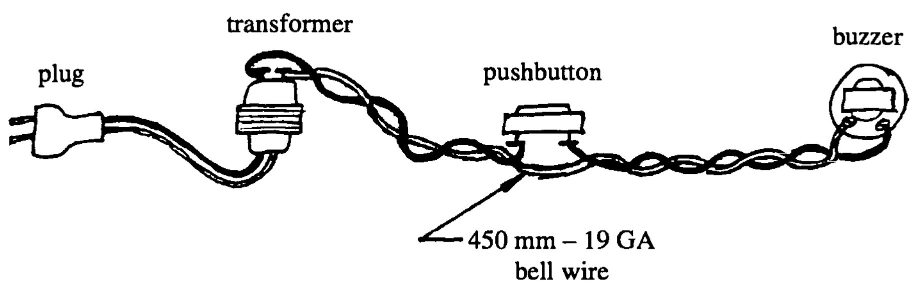
ELT1010 Electro-assembly 1

BASIC CIRCUITRY

Lamp Circuit

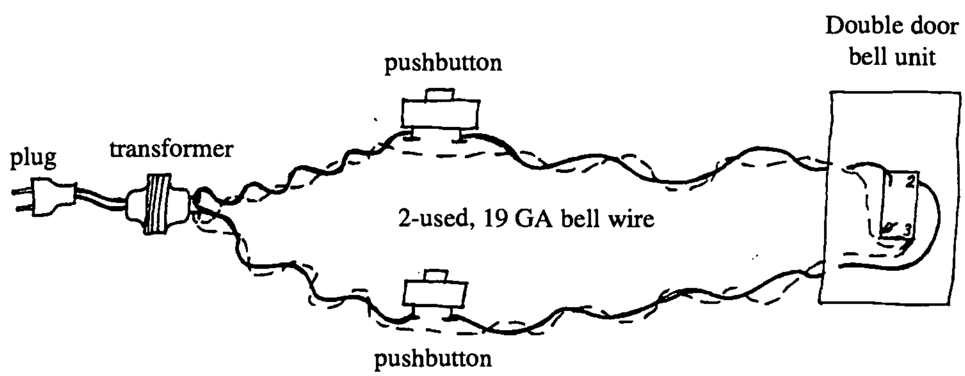


Single Doorbell



Do not unravel (untwist) the bell wire

Double Doorbell



——— 1 black to #1, black to #2

- - - - - - Both white to #3 N.C. on Ø

ELT1010 Electro-assembly 1

Student's Name ____________

Measuring Instruments

Answer the following questions:

1. How many instruments measure AC?
2. How many instruments measure DC?
3. How many instruments measure V?
4, How many instruments measure A?
5. How many instruments measure Ω ?

Start time: End time:

Cell and Battery Measuring Exercise

		Analogue		Digital	
Cell or Battery	#, Letter	V	A	V	A
AA					
AA					
C					
C					
D					
D					
9V					
9V					
4½V					
6V					
12V					

Marks			
Speed of work	1	2	3
Accuracy	1	2	3
Neatness	1	2	3
Complete	+1		
			/10

Marks			
Speed of work	1	2	3
Accuracy	1	2	3
Neatness	1	2	3
Complete	+1		
			/10

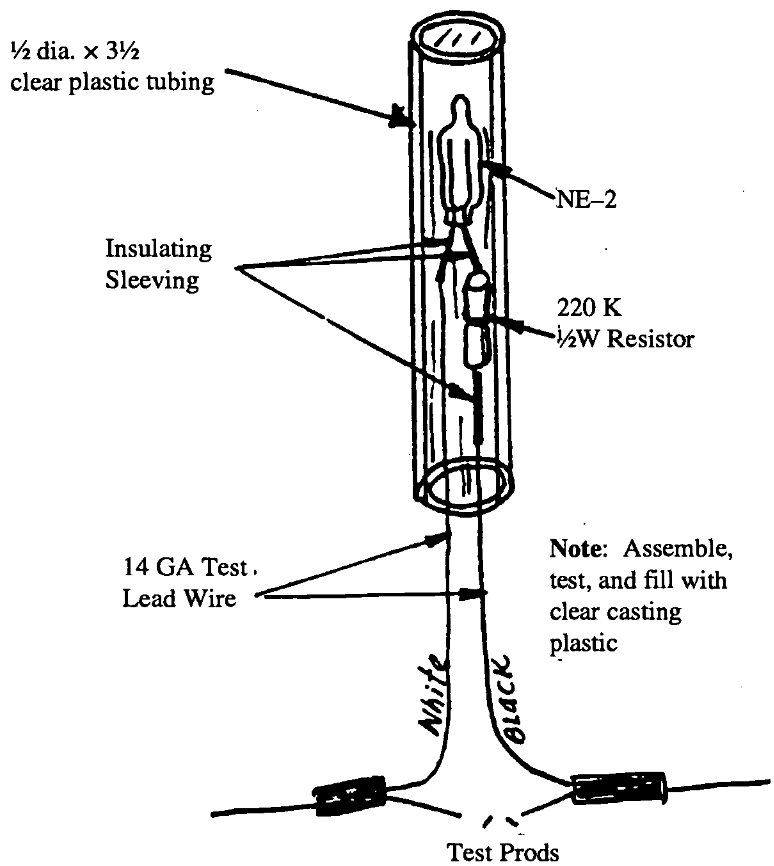
Resistance Measuring Exercise

#	Colour Code	Value	Tolerance	Tolerance Range	Measured	Comment
0	brown, violet, green, silver	1 700 000	±10%	1 530 000 – 1 870 000	1 690 000	good
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Ideas and Methods

Electricity Circuit Tester

Idea by GrayMark
Instructions by St. Albert Industrial
Education Teachers Group



Electrical Tester

ELT1010 Electro-assembly 1

1. Measure and cut a 9 cm piece of acrylic tube.
2. File, sand and buff only one end of this piece of tube.
3. Obtain the remainder of the materials from the instructor.
4. Study the diagram for the procedure in making a Western Union splice.
5. Position the resistor about 15 mm from the neon lamp and use the Western Union splice to connect the two leads together.
6. Strip off 1 cm of insulation from one end of each number 14 wire.
7. Twist together one lead from the neon lamp with one of the number 14 lead wires.
8. Twist the other lead from the resistor to the second number 14 lead wire.
9. CHECKPOINT
   Have your teacher inspect your connections and give you a soldering demonstration if necessary.
10. Solder the connections.
11. Insert the assembled components into the tube until the end of the neon bulb is 10 mm from the end of the tube.
12. Now bend the two lead wires over opposite edges of the other end of the tube to keep the components in place.
13. Have the instructor check your work at this point.
14. Place masking tape over the open end of the tube and place the tube in the holding jig taped end down. Put your name on the masking tape.
15. Put on a face shield.
16. Have the instructor assist you in mixing the resin and catalyst.
    Note: Catalyst is highly dangerous to the eyes.
17. Pour the mixture into the tube until it is full. Leave the rest of the mixture in the cup.
18. Carefully remove the tube from the jig and place it in the storage cupboard. It will take 12 hours to set.
19. After the resin is set, remove the masking tape and file or sand the end of the tube down to the level of the resin.
20. Use wet and dry sand paper to give a smooth finish to the top of the tester.
21. Obtain permission to use the buffer and buff the top of the tester.
    WEAR EYE PROTECTION.
22. Cut the longer lead end to the same length as the shorter one.
23. Strip 10 mm of the insulation from both leads of the tester.
24. Have the instructor test and mark your project.

CAREER & TECHNOLOGY STUDIES

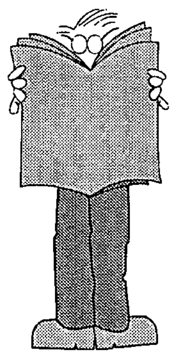
ELECTRO-TECHNOLOGIES

SAMPLE STUDENT LEARNING GUIDE

ELT1130 Robotics 1

ELT1130 Robotics 1

WHY TAKE THIS MODULE?



Industries of all kinds use robots to perform repetitive tasks or hazardous work. They might be used to weld, fasten or paint automobile parts or transport goods in a factory or warehouse or to remove and dispose of a bomb and in the process, save human life!

Watching a robot in action can give you the impression that these machines have an intelligence of their own. In fact robots must be designed and programmed by humans.

Are you ready for an exciting and intense study of robotics?

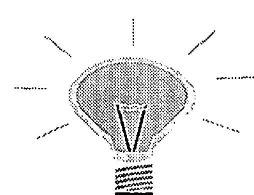
In this module you will learn the basics in the world of robots. You will program a commercial robot and make it perform useful tasks. You will also design, assemble and program robots from kits to solve problems.

WHAT DO YOU NEED TO KNOW BEFORE YOU START?

Prerequisite: ELT1010 Electro-assembly 1

In addition, you should be able to:

- use basic hand tools in a safe manner
- be able to follow instructions as given in tutorial and assembly manuals
- work very hard and use time wisely
- enjoy assembling kits
- demonstrate a positive attitude to problem solving (e.g., stick to the task even when the going gets tough).



ELT1130 Robotics 1

WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

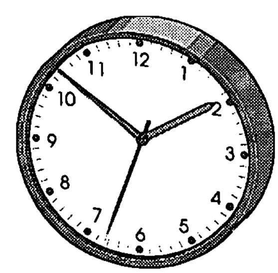
Upon completion of this module you will be able to:

- describe the evolution and applications of robotic systems
- identify and classify robotic systems and subsystems
- design and build a direct control robotic system
- demonstrate established laboratory procedures and safe work practices
- demonstrate basic competencies.

WHEN SHOULD YOUR WORK BE DONE?

Your teacher will give you a timeline for completing tasks and assignments within this module.

You may also wish to use a time-management planning chart to preplan the work that needs to be done in this module. Plan how you will use your class time as well as extra time needed to complete the assignments in this module.



HOW WILL YOUR MARK FOR THIS MODULE BE DETERMINED?

You must first demonstrate **all** of the competencies required for this module.

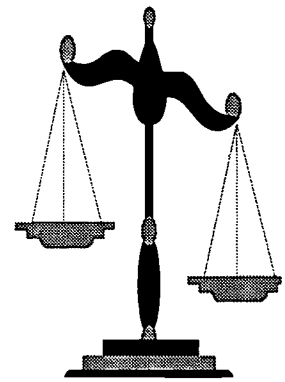
When you have done this, your mark will be determined as follows:

Each of the three major sections of this module has its own evaluation sheet. Your marks on each sheet will be determined by your own evaluation of your work and by your teacher's evaluation. Your final mark for this module will be totalled from these three sheets.

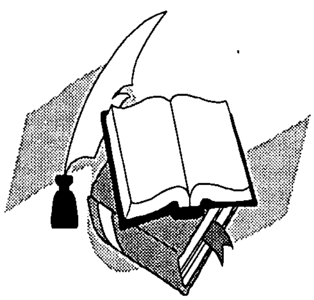
When you have completed any of sections A, B or C find the evaluation sheet near the back of this package and fill in the student column.

The following graphic will remind you during each section.

Remember to complete your self-evaluation!



WHICH RESOURCES MAY YOU USE?



- *Robix Construction Techniques* (Video)
- *Robix RCS–6 Models* (Video)
- *Eshed – Robotics Training Program*:
  - Textbook 1 *Fundamentals of Robotics*
  - Textbook 3 *Robotic Laboratory Experiments*
  - Textbook 4 *Robotic Structure*
  - Workbook 1 *Fundamentals of Robotics*
  - Workbook 3 *Robotic Laboratory Experiments*
  - Workbook 4 *Robotic Structure*
- *Eshed – Advanced Robotics Laboratories*, Booklet 2, Accessory Exp.

Robix RCS–6 Robot Kit and **Computer**
- *Robix Software* V1.03
- *Robix User's Guide* and Project Book

Lego Dacta
- *Construction Kit #9701*
- *Lego Control Lab Software* V1.0
- *Technology Investigations and Inventions*, Lego Dacta
- *Quick Start Guide*, Lego Dacta
- *Reference Guide*, Lego Dacta

General Reference
- *Robotics Curriculum Package* #1 and 2 by Brian Rutherford
- *The Robot Builders Bonanza*; 99 Inexpensive Robotics Projects by Gordon McComb
- *Introduction to Robots*, Mid-America Vocational Curriculum Consortium
- *The Way Things Work*, David Macaulay
- *Isaac Asimov's "The Ultimate Robot"* CD ROM for Mac

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ACTIVITIES/WORKSHEETS

Each section below has a list and description of your assignments and activities. There are two blanks by each activity. One is for you to write in your estimated completion date and the other is for your teacher's initials, which you should obtain as soon as you have completed a section. Budget your time wisely. To help you remain accountable for your time, during the first class hand in the completed due date sheet at the back of this package. The dates on this sheet should match the dates you estimate for the activities below.

SECTION A: Introduction to Robots and Fundamentals of Robotics (Sample Activities)

In this section you will be thoroughly immersed into the world of robotics. You will complete a test to see how much you know about robotics before you start and another test at the end to measure how much you learned. You will have the opportunity to teach, program and operate the Scorbot robot arm and use it to solve exciting problems like bomb disposal. The Scorbot robot arm is a commercial model. Variations of this accurate robot are used for laser surgery.

Time Budget: Approximately 9 hours

1. Introduction to Robots: Pretest — Date __________ Init. ________
   - ☐ Locate "Introduction to Robotics." Answer the questions to the pretest on the sheet provided in this package. This test measures your knowledge of robotics before you start. You need not worry about not knowing all answers as the mark for the test will not count in the module mark. This must, however, be completed. Ask for the marking guide when complete.

Don't forget to get your instructor to initial your activities when complete

2. Introduction to Robots: Activities 1–10 — Date __________ Init. ________
   - ☐ Locate "Introduction to Robotics" and the robot arm. Ten activities can be found. If you read carefully, the step-by-step nature of the material will guide you through all activities. If you really feel that you are stuck, ask your instructor for help. Each activity has review questions at the end. These questions are to be answered neatly in your notebook and should be ready for inspection at the end of this section.

Remember to complete your self-evaluation!

3. Introduction to Robots: Post-test — Date __________ ________
   - ☐ Ask your instructor for the post-test. Answer these questions on the sheet provided in this package. This test measures your knowledge of robotics now that you have completed ten activities. The mark for this test will be counted in your module mark.

4. Robotics Fundamentals Chapters 1–5 and worksheets — Date ________ Init. ________
   - ☐ Attached to this package is a handout entitled "Robotic Fundamentals." This handout is your textbook and includes worksheets on the chapters, which should be completed to help you prepare for the quiz below.

5. Robotics Fundamentals Chapters 1–5 Quiz — Date ________ Init. ________
   - ☐ When you are ready ask your instructor for this quiz.

6. Section Evaluation — Date ________ Init. ________

SECTION B: Robix and Lego Dacta – Robot Model Construction and Programming

In this section you will have the opportunity to work with some incredible Lego and a robotics kit. The exercises in this section take you beyond the "robot arm" to other robotic models. Both of these systems are very flexible and leave lots of room for creativity. If you enjoyed playing with Lego when you were younger you will enjoy these kits. Be careful, however, not to spend too much of your time with building and assembling, because you will be required to program and make your robot models operational.

Time Budget: Approximately 9 hours

1. Robotics RCS–6 Robot Project — Date ________ Init. ________
   - ☐ Locate the robix components and user's guide inside. You will also need two videos, one entitled *RCS 6 Construction Techniques* and the other *RCS 6 Models*. Ask your instructor which computer you will use and how to load the Robix software.
   - ☐ You should start by watching the models video. This video will inspire you and show you the potential of the Robix system. Look for the footage of a model named "strider" (looks like a little man with eyes); this will be your first project. Watching a few minutes of the construction video will help you with the assembly techniques. Detailed construction and programming help along with actual program code for the "strider" can be found in the user's guide. Demonstrate this model to your instructor when complete.

2. Lego Dacta Robotics and Automation — Date ________ Init. ________
   - ☐ Obtain the 9701 Lego Dacta Kit. Build the robotic arm model. An assembly diagram (#9701–7) for this model is in the kit. Once the robot is assembled, obtain the computer interface controller, the reference guide and the book entitled "Technology Investigations and Inventions."

   Important: The Lego kits are very expensive and contain many pieces. Part of your mark for this section is taken from your ability to manage the kit effectively; i.e., no missing pieces!

- ☐ Ask your instructor which computer has the Control Lab V1.0 software. Read chapter one in the Reference Guide. This chapter will familiarize you with the software and interface controls.

- ☐ Now open the Technology Investigations and Inventions book to page 2.1. This is where the fun begins. Pages 2.1 to 2.3 get you warmed up to the problem you are going to solve with your robot. Page 2.5 gives you the suggested hookups to the interface/ controller. Starting on page 2.6 you will need to concentrate on the instructions. They will step you through all procedures concerning the set-up page, the command centre, the project page and the procedures page. The actual coding for the procedures page can be found on page 2.12.

- ☐ You can expect some difficulties along the way. There are many details to pay attention to in order to get the robot model working correctly. Don't allow yourself to get too frustrated. Take your time (take a break if needed) and retrace your steps through the manual. If you have read all the required pages and feel that you have done your best, but still can't solve the problem, ask your instructor for help.

Remember to complete your self-evaluation!

- ☐ Once you have the robot functioning correctly, demonstrate it to your instructor.

- ☐ Now feel free to modify this Lego model. Use no more than one class period to add more motors or sensors or change the programming to perform a different task.

- ☐ Now return your Lego Dacta kit to the organized condition shown on the side of the box. Make sure your kit contains all of the required pieces as outlined on the inventory pages in the kit's manual. Have your instructor inspect your kit and initial this activity.

3. Section Evaluation — Date __________ Init. ________

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SECTION C: Robotics Projects

In this section you will test your combined knowledge of robotics and your creative and innovative abilities. By now you have seen a variety of robot applications in the various books and videos used in this module. It's time for you to come up with your own application for robotics.

Time Budget: Approximately 7 hours

Choices

Your own original idea! *(not for the faint of heart)* Date __________ Init. ________

- ☐ Use one of the available robotic systems in the lab to design a solution for your own problem. Explain your idea to your instructor before you start. Now complete a basic plan that states your objectives (the problem[s] you are going to solve) and outline the basic steps you will need to follow to complete your project. A simple flow chart like those available in the Claris Impact software would work here.

Or

Using the Robix RCS–6 system

- ☐ Assemble, program and demonstrate two of the models shown in the video (other than the strider).

Or

Scorbot ER3 Robot Arm

- ☐ Complete activity 11 in "Introduction to Robots."

Plus

Lego Dacta

- ☐ Complete and demonstrate one more model from the plans in the Lego kit.

Remember to complete your self-evaluation!

Section Evaluation Date __________ Init. ________

Are You Done?

Feel free to spend your remaining module time exploring Isaac Asimov's robot world on the Mac. CD-ROM game "The Ultimate Robot"

K. ACKNOWLEDGEMENTS

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